PROPOSED PLAN
STAR LAKE CANAL SUPERFUND SITE
PORT NECHES, TEXAS

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 6

June 2013

EPA PROPOSES FINAL SITE REMEDY

This Proposed Plan identifies the Preferred Alternatives for addressing contamination at the Star Lake Canal Superfund Site in Jefferson County, Texas. The Proposed Plan will also provide the rationale for the selection of the Preferred Alternatives. This Proposed Plan is issued by EPA, the lead enforcement agency for Site activities. Input by the Texas Commission on Environmental Quality (TCEQ) and the Natural Resource Trustees, both State and Federal, was considered during the selection of the Preferred Alternatives. The lead agency for communication and coordination of Site activities is the Environmental Protection Agency (EPA). This Proposed Plan is available on the internet at http://www.epa.gov/region6/6sf/6sf-decisiondocs.htm

The EPA, in consultation with TCEQ, will select a final remedy after considering all information submitted during a 30-day public comment period. Attachment 1 provides a Comment Sheet to provide EPA with comments during the public comment period. The EPA may modify the Preferred Alternative or select another response action based on new information or public comments. The public is encouraged to comment on the alternatives presented in this Proposed Plan or to suggest other alternatives. A glossary is included at the end of this document to define key terms.

PURPOSE OF THE PROPOSED PLAN

- Present EPA's rationale to the public for the proposed cleanup of contamination at the Star Lake Canal Superfund Site
- Solicit public review and comment on the proposed action and the supporting documents contained in the Administrative Record file
- Provide history and background information about the Site
- Provide details about where additional information is available

The EPA is issuing this Proposed Plan in accordance with and as part of its public participation responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act, as amended (CERCLA), Section 113(k)(2)(B), 117(a), and 121(f)(1)(G), 42 U.S.C. §9613(k)(2)(B), 9617(a), and

9621(f)(1)(G) and under Sections 300.430(f)(2) and (3) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This Proposed Plan summarizes information that can be found in greater detail in the Final Remedial Investigation (RI) Report, Final Feasibility Study (FS) Report, and other documents contained in the administrative record file for the Site.

The EPA encourages the public to review the Administrative Record file for more information and a comprehensive understanding of the Site and the activities completed at the Site. The Administrative Record File can be found at the following locations:

Port Neches
Effie & Wilton Hebert Public Library
2025 Merriman Street
Port Neches, TX 77651
(409) 722-4554

Texas Commission on Environmental Quality Central File Room
12100 Park 35 Circle
Building E, First Floor, Room 103
Austin TX 78753
512-239-2900
512-239-1850 (fax)

PUBLIC COMMENT PERIOD AND MEETING

PUBLIC COMMENT PERIOD:

June 21, 2013 – July 20, 2013
EPA will accept written comments on the Proposed Plan during the comment period.

PUBLIC MEETING:

July 11, 2013
Effie & Wilton Hebert Public Library
2025 Merriman Street, Port Neches, TX at 6:00 pm – 8:00 p.m.
Oral and written comments will be accepted at the meeting.

COMMUNITY PARTICIPATION

The public is invited to comment on the RI, FS, and Proposed Plan for the Site. The public comment period begins on June 21, 2013, and ends on July 20, 2013. During the public comment period, written comments may be submitted to:

Bill Little
U.S. EPA (6SF-VO)
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733
little.bill@epa.gov

Additionally, oral comments will be accepted at a public meeting scheduled for Thursday, July 11, 2013, beginning at 6:00 p.m., at the Effie & Wilton Hebert Public Library, 2025 Merriman Street, Port Neches, TX.

The EPA will respond to all comments received on this Proposed Plan received during the public comment period in a document called a Responsiveness Summary. The Responsiveness Summary will be attached to the Record of Decision (ROD) for this Site and made available to the public in the information repositories. The ROD explains the remedial action selected for use at this Site. The remedy may be different from the preferred alternative identified in this Proposed Plan based on comments, new information, or issues received during the public comment period. Any aspects of the proposed action that are significantly different from the Proposed Plan will be explained in the ROD. The ROD will be signed by the EPA Region 6 Division Director.

Information about the public involvement process and answers to questions about activities at the Site can be obtained from the following individuals:

Gary Miller
U.S. EPA (6SF-RA)
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 665-8318
miller.garyg@epa.gov

Bill Little
U.S. EPA (6SF-VO)
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 665-8131 or 1 (800) 533-3508 (toll free)
little.bill@epa.gov

Media inquiries should be directed to the EPA Press Office at (214) 665-2200.

SITE BACKGROUND

The Star Lake Canal Superfund site is located in Jefferson County, in and around the cities of Port Neches and Groves, Texas. The site has been divided into seven areas of investigation (AOI): Jefferson Canal, Jefferson Canal Spoil Pile, Former Star Lake, Star Lake Canal, Gulf States Utility Canal, Molasses Bayou Waterway, and the Molasses Bayou Wetland. The site location and the boundaries of the seven AOIs are shown in Figure One and Figure Two. The site is defined as the lengths of the two industrial canals from their origins to the confluence of Star Lake Canal with the Neches River and the adjacent wetlands. The straight-line distance along Star Lake Canal from its origin east of the intersection of Highway 136 and FM 366 to its confluence with the Neches River is approximately 16,500 feet. The straight-line distance along Jefferson Canal from its origin on the east side of Hogaboom Road south of FM 366 to its confluence with Star Lake Canal north of the Hurricane Protection Levee is approximately 4,000 feet. Molasses Bayou is located southeast of the Star Lake Canal and intersects the canal in two locations. The Gulf States Utility Canal is a canal that resulted during the recent placement of a buried utility line and is located parallel to and approximately 100-200 feet northwest of the Star Lake Canal. The Gulf States Utility Canal extends from the Neches River to a point approximately 500 feet downstream from Sara Jane Road.

Industrial operations have occurred in the area surrounding the site since the early 1940s, and continue to the present date. Jefferson and Star Lake Canals have received industrial wastewater and stormwater discharges from local chemical and other manufacturing facilities for a number of years. Star Lake and Jefferson Canals have been used by the surrounding industry for permitted discharge of industrial effluents. The discharges have occasionally exceeded allowable limits for some constituents and this has resulted in the deposition of potentially hazardous constituents at the Site. In 1983, the Jefferson County Drainage District Number 7 (DD #7) dredged the Jefferson Canal after acquiring an easement on the canal from Texaco Chemical Company. The DD #7 deposited dredged materials onto the banks of Jefferson Canal in and around an area south of FM Road 366. The deposited dredged material was subsequently determined to contain potentially hazardous constituents. The area where the dredged material was deposited is identified as the Jefferson Canal Spoil Pile AOI. Contaminated sediment in Jefferson Canal, Former Star Lake, Star Lake Canal, Gulf States Utility Canal, Molasses Bayou Waterway, and Molasses Bayou Wetland serve as source material for contaminants to the aquatic organisms. Contaminated soil in the Jefferson Canal Spoil Pile serves as a source for contaminants to terrestrial organisms and to the aquatic environment. The contaminated

sediment and soil act as a reservoir for contamination and as a source for direct exposure to aquatic and terrestrial organisms. The contaminated sediment and soil are not highly mobile, do not pose a high risk to human health and therefore are not considered to be principal threat wastes. Sediment and soil are source materials that can be reliably contained and can be addressed through containment technology, and therefore are considered to be low level threat waste.

A large portion of the Star Lake Canal watershed is dominated by commercial and industrial land use. The primary habitat at the site appears to be open water canals and bayous bordered by emergent wetlands. The emergent wetlands appear to be dominated largely by *Phragmites*, *Juncus*, and *Spartina* vegetation. Unconsolidated sediments appear to comprise the bottom of the Star Lake and Jefferson Canals as well as portions of Molasses Bayou. There exists a potential for area residents to use portions of the bayou for recreational purposes and for fishing. Based upon the February 1998 report entitled *Expanded Site Inspection Work Plan* jointly prepared by the Texas Commission on Environmental Quality (TCEQ, formerly the Texas Natural Resource Conservation Commission [TNRCC]) and the EPA, there are no surface water uses and no drinking water intakes in the study area. There are no public groundwater wells within a four mile radius, and the one private groundwater well in the vicinity is upgradient of the site. Groundwater is not part of the scope of this Proposed Plan. If, after monitoring, groundwater is found to be contaminated above protective levels it will be addressed in a future decision document to return it to its beneficial uses.

Previous Investigations

Texas investigations conducted during the 1970s focused on pentachlorophenol and toxaphene constituents in the Jefferson Canal sediment. In 1983, sediments impacted with toxaphene were identified that may have been dredged from the canal and placed on its banks. In 1983, an analytical report from a single sample of disposed dredged material revealed concentrations of toxaphene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(p)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and biphenyls above the laboratory detection limits.

On March 21 and March 23, 1983, the Texas Department of Water Resources (TDWR) collected sediment samples from Jefferson Canal, dredged spoil samples from the banks of Jefferson Canal, and made observations on rainfall and runoff from the dredged materials. Samples were noted to have a strong aromatic odor characteristic of phenolic compounds. The TDWR inspection also revealed rainfall and runoff from dredged materials along the Jefferson Canal bank entering Jefferson Canal. A further review of state records indicated that sampling of dredged materials from Jefferson Canal sediments documented the presence of concentrations of polycyclic aromatic hydrocarbons (PAHs) including naphthalene, acenaphthylene, fluorene, phenanthrene, anthracene, pyrene, benzo(a)anthracene, benzo-b-fluoranthene, benzo(a)pyrene, benzo-a-fluoranthene, and chrysene at concentrations above the laboratory detection limits. Soil on property adjacent to the Jefferson Canal was found to contain toxaphene and possibly pentachlorophenol at concentrations above the laboratory detection limits.

A TCEQ Screening Site Inspection (SSI) Report of the Star Lake Canal, dated September 1997, indicated that the following constituents were detected in samples collected from the Jefferson and Star Lake Canals above the laboratory detection limit: acenaphthene, acenaphthylene, anthracene, arsenic, barium, benzo(b)fluoranthene, benzo(k)fluoranthene, cyanide, fluoranthene, fluorene, mercury, 2-methylnaphthalene, naphthalene, aroclor-1254 (a polychlorinated biphenyl [PCB]), phenanthrene, pyrene, and thallium. A table of organic constituents in the samples contained a hand-written entry that indicated that benzo(a)anthracene, chrysene, and benzo(a)pyrene were also detected.

A TCEQ Expanded Site Inspection (ESI) Report for Star Lake Canal Site, dated January 1999, included other constituents not listed in the 1997 SSI report, including: acetone, aldrin, benzene, benzo(g,h,i)pyrelene, chromium, copper, 4,4'-DDD, endosulfan I, ethylbenzene, heptachlor epoxide, indeno(1,2,3-cd)pyrelene, selenium, silver, styrene, toluene, and total xylenes. However, arsenic, barium, cyanide, and mercury previously reported in the 1997 SSI report were not reported in the ESI.

On July 22, 1999, the EPA proposed the addition of the Star Lake Canal Site to the National Priority List (NPL). On August 28, 2000, and pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 U.S.C. § 9605) the Site was added to the NPL (40 C.F.R. Part 300, App. B).

In March of 2001 the Texas Department of Health in coordination with the Agency for Toxic Substances and Disease Registry (ATSDR) released a Public Health Assessment.

On December 22, 2005, EPA, Chevron Environmental Management Company (CEMC) and Huntsman Petrochemical Corporation (Huntsman) signed an Administrative Order on Consent (AOC) to perform a Remedial Investigation and Feasibility Study (RI/FS).

Concurrent Regulatory Actions

Huntsman is currently conducting a groundwater corrective action monitoring program at their Port Neches Performance Products (PNPP) facility under the TCEQ Site-Wide Groundwater Corrective Action Monitoring Program. The objective of the groundwater monitoring program is to document the vertical and horizontal extent of the existing groundwater plume. The Corrective Action Monitoring Program will also monitor the effectiveness and progress of naturally occurring biodegradation processes that are attenuating and degrading the contaminants of concern (COCs) in the groundwater within the two uppermost water-bearing zones beneath the facility.

SITE CHARACTERISTICS

Based on the findings of the RI, the Human Health Risk Assessment (HHRA), and the Baseline Ecological Risk Assessment (BERA), the following seven areas of the Site are being addressed by this Proposed Plan:

- Jefferson Canal
- Jefferson Canal Spoil Pile
- Former Star Lake
- Star Lake Canal
- Gulf States Utility Canal
- Molasses Bayou Waterway
- Molasses Bayou Wetland

Jefferson Canal

The Jefferson Canal Upstream Area of Investigation (AOI) includes the Huntsman facility stormwater conveyance and the western portion of Jefferson Canal between Hogaboom Road and FM 366. This section

of the canal is frequently dry or contains stagnant water resulting from rainfall/runoff; however, the canal will receive discharge from surrounding industries during severe rainfall events when secondary facility outfalls must be utilized. Public access to the entire upstream portion of Jefferson Canal is limited by a secure 8-feet tall, chain link fence. The Jefferson Canal Downstream AOI includes the northern portion of Jefferson Canal between FM 366 and its confluence with Star Lake Canal. The upstream and downstream portions of Jefferson Canal are separated by a section of the canal that runs parallel to FM 366 that is severely overgrown and allows no or very low flow of surface water except during severe rainfall/runoff events or secondary facility outfall usage. The downstream portion of the canal contains intermittent stagnant and low flowing water and portions of the canal are overgrown with vegetation. Based on test results, all sediment and water samples in the Jefferson Canal AOI were freshwater samples. The upstream portion of the Jefferson Canal AOI is outside the 500-year floodplain; whereas, the lower portion of the canal is inside the 100-year to 500-year floodplain.

Jefferson Canal Spoil Pile

The Jefferson Canal Spoil Pile AOI includes the area on the western bank of Jefferson Canal between FM 366 and Star Lake Canal. This area contains dredged material that was deposited on the bank of Jefferson Canal. The dredged material formed mounds that are 2 to 5 feet high in most locations. A topographic map that shows the mounds is presented in the Final Tier Two RI Report (Fig 4-7). This AOI has several underground pipelines crossing through it. The Jefferson Canal Spoil Pile AOI is inside the 100-year to 500-year floodplain.

Former Star Lake

The Former Star Lake AOI includes the area of the former Star Lake southwest of Atlantic Road to the northwest and southeast of Star Lake Canal. The area consists of low-lying land that can become saturated with water during severe rainfall/runoff events. The area of the former Star Lake was identified on the 1938 aerial photograph and has been silted in. The current conditions are shown on the 2007 aerial photograph. The Former Star Lake AOI is inside the 100-year to 500-year floodplain.

Star Lake Canal

The Star Lake Canal AOI includes the entire length of the canal from Orchard Road to its confluence with the Neches River. Star Lake Canal represents a continuous open water man-made channel with elevated banks that flows into the Neches River. The sediment and surface water samples collected in the upstream portion of Star Lake Canal were freshwater samples and the remaining samples were considered saltwater samples. The upstream portion of the Star Lake Canal AOI is outside the 500-year floodplain, the middle portion of canal is inside the 100-year to 500-year floodplain and the lower portion of the canal is inside the 100-year floodplain.

Gulf States Utility Canal

The Gulf States Utility Canal AOI includes the entire length of the canal that runs parallel to Star Lake Canal. Gulf States Utility Canal represents a continuous open water man-made channel with elevated banks that connects to Star Lake Canal at discrete locations. Based on test results, all sediment and surface water samples in the Gulf States Utility Canal AOI were saltwater samples. The Gulf States Utility Canal AOI is inside the 100-year floodplain.

Molasses Bayou Waterway

The Molasses Bayou Waterway AOI includes a narrow water channel that traverses the Molasses Bayou Wetland. The upstream portion of Molasses Bayou is a naturally occurring, open water channel surrounded by marsh and wetlands. The Molasses Bayou Downstream Watercourse AOI includes the portion of Molasses Bayou from near its split to its confluence with the Neches River. This portion of the bayou consists of a naturally occurring open water channel surrounded by marsh and wetlands with the exception of a portion that has silted in and no longer contains standing water from the point where it splits from the bayou. Historic aerial photographs indicate that this silted in portion was historically an open water channel. All sediment and surface water samples in the Molasses Bayou Waterway AOI were saltwater samples. The Molasses Bayou Waterway AOI is inside the 100-year floodplain.

Molasses Bayou Wetland

The Molasses Bayou Wetland AOI includes the marsh and wetland areas that surround the Molasses Bayou watercourse. The wetland area consists of low-lying land that can become saturated with water during severe rainfall/runoff events. All sediment and surface water samples in the Molasses Bayou Wetland AOI were evaluated as saltwater samples. The Molasses Bayou Wetland AOI is inside the 100-year floodplain.

SCOPE AND ROLE

This is the first CERCLA response action to be conducted at the Site. This action will address hazardous substances that were deposited into sediment through the historic and permit-exceedance discharges of wastewater and stormwater runoff from industrial facilities into Star Lake Canal and Jefferson Canal. Contaminated sediment will also be addressed in wetland areas that are connected to Star Lake Canal and Jefferson Canal. This includes the Former Star Lake, Gulf States Utility Canal, Molasses Bayou Waterway, and the Molasses Bayou Wetland AOIs. The action will also address the soil that was contaminated by sediment that was dredged from Jefferson Canal. Groundwater will not be addressed by this action as it is currently being addressed by the TCEQ Groundwater Corrective Action Monitoring Program.

SUMMARY OF SITE RISK

As part of the RI/FS, a baseline human health risk assessment (HHRA) and a baseline ecological risk assessment (BERA) were conducted to evaluate the current and future effects of contaminants found in soil, sediment, surface water and biota on human and ecological receptors. During the RI a total of 65 surface water samples, 258 sediment samples, and 108 soil samples were collected. In addition to this 40 fish tissue samples were collected for the HHRA and 70 tissue samples were collected for the BERA. Both the HHRA and the BERA risk assessments were conducted in a two-tier process. The first tier served as a screening level and to guide a more site specific and comprehensive risk assessment in the second tier. The results for the first tier are presented in the Tier One Remedial Investigation Report and the results of the second tier are presented in the Final Tier Two Remedial Investigation Report. Following the completion of the RI an Alignment Document and a Sensitivity Analysis were completed to resolve issues and facilitate the completion of the FS. The results of the sensitivity analysis are presented in the Final FS Report.

During the Remedial Investigation seven areas of investigation (AOIs) were established. This was done because of the size of the site, the different habitat types, to simplify the sampling design, and to simplify the decision making process. For some upper trophic level receptors (UTLs) that have a large home range, the data from the entire site was used to calculate risk. For receptors with a limited range, the risk was

calculated on an AOI basis or using data from individual sample locations. After completion of the RI the AOIs were divided again to allow for a more focused assessment of risks to benthic invertebrates. Individual areas were identified where the risk to benthic invertebrates was determined to be medium-high or high. Because of this, areas in the FS are described using Thiessen polygons or AOIs. Figure 3 shows the sub-areas (Thiessen polygons) and AOIs.

Human Health Risks

The human health risk assessment focused on the potential for human health effects from exposure to contaminants at the site.. Jefferson Canal Spoil Pile soil results were compared to Texas Commission on Environmental Quality (TCEQ) Commercial / Industrial Protective Concentration Levels for incidental ingestion, dermal or skin contact, and the inhalation of chemicals emitted from the soil. Surface water and sediment sample results were compared to the TCEQ Contact Recreation Water Protective Concentration Levels for the incidental ingestion of surface water and dermal or skin contact with surface water. In addition, surface water sample results were compared to human health surface water TCEQ Risk-Based Exposure Limits (RBELs) for non-drinking water body for the consumption of fish. As part of the risk assessment, the exposure to harmful chemicals that a person could have while engaged in various activities or scenarios was calculated, and the risk from this exposure was evaluated. The scenarios and activities evaluated include recreational swimming, wading, recreational fishing, trespass wading, trespass fishing, industrial worker, and outside worker. The potential human health risk from groundwater was not considered in the human health risk assessment because Huntsman is currently conducting a groundwater corrective action monitoring program at the adjacent Huntsman PNPP facility under TCEQ's Corrective Action Program in accordance with the Resource Conservation and Recovery Act (RCRA).

The human health risk assessment indicated that the potential human health risk from the site is low and does not pose an unacceptable risk for human receptors that may use the site. The calculated non-carcinogen hazard indexes (HI) for all receptors were below the level of 1 which indicates that non-cancer health effects are unlikely to occur. The risk of cancer from exposure to a chemical is described in terms of the probability that an individual may develop cancer because of a lifetime of exposure (i.e., 70 years). In general, the EPA considers lifetime excess cancer risks that are below 1 chance in 1,000,000 (1×10^{-6} or 1E-06) to be so small as to be negligible, and risks above 1 chance in 10,000 (1×10^{-4} or 1E-04) to be sufficiently large that remediation is generally warranted. Excess cancer risks that range between 1E-06 and 1E-04 are generally considered to be acceptable, but this is evaluated on a case-by-case basis and the EPA may determine that risks lower than 1E-04 are not sufficiently protective and warrant remedial action. The calculated cancer risk for all receptor scenarios at the Star Lake Canal Site is less than 1 chance in 10,000 or (1×10^{-4} or 1E-04). The primary risk driver is consumption of fish and shellfish caught at the site. As the site is primarily an industrial site with limited access for fishing by the general public it was determined that the cancer risk is acceptable.

Therefore, no Remedial Action Objectives (RAOs) were needed or developed for the protection of human health.

Ecological Risks

The first tier of the ecological risk assessment is called a screening level ecological risk assessment (SLERA). The results of the SLERA are presented in the Tier One RI Report. The SLERA was used to produce a list of contaminants of potential ecological concern (COPECs) and to define the extent of the contamination. The results of the SLERA showed that at least one screening level benchmark was exceeded

at every sediment sampling location. All of the soil samples collected at the site came from the Jefferson Canal Spoil Pile AOI and the results indicated that soil from this AOI also exceeded the ecological screening benchmarks. At the conclusion of the SLERA, 26 volatile organic compounds (VOCs), 32 semi-volatile organic compounds (SVOCs), 20 pesticides, 26 metals, PAHs, and PCBs were retained as COPECs in soil or sediment. The identified COPECs were carried forward for a more thorough analysis in the BERA.

The BERA focused on the potential for ecological receptors to be harmed by exposure to contaminants in environmental media such as soil, surface water, and sediment. The BERA also evaluated the risk of ingesting contaminants that accumulated in plants and animals that are part of the food chain. The ecological receptors identified as assessment endpoints included avian, reptilian, terrestrial mammal, terrestrial invertebrate, terrestrial plant, fish, and benthic invertebrate populations. The receptors of concern include species observed during field observations as well as threatened and endangered species identified based on a habitat suitability approach for the area. The receptors of concern for the BERA, as identified in the *Final Tier 2 Remedial Investigation Report*, include the Green Heron, White-Faced Ibis, Belted Kingfisher, Marsh Wren, Mallard, Muskrat, Raccoon, Brown Pelican, American Robin, Short-Tailed Shrew, Spotted Sandpiper, Painted Turtle, Wood Stork, Reddish Egret, and Bullfrog.

Benthic invertebrates are small aquatic insects and animals that live at the bottom of water bodies. Benthic invertebrates are frequently evaluated in ecological risk assessments because they are an important component of the aquatic food chain. In addition to this the small size, limited mobility and prolonged contact that benthic invertebrates have with water and sediment make them a good indicator of the risk from hazardous chemicals. The potential risk to benthic invertebrates was evaluated using a weight of evidence approach to reduce the uncertainty associated with making a decision based on a single line of evidence. Risk to benthic invertebrates was evaluated at each sample location because of the small home range and lack of mobility of these receptors. The lines of evidence used to evaluate the risk to benthic invertebrates are described below.

1. The effect range medium quotient (ERM-Q) and probable effect level quotient (PEL-Q) method uses sediment quality guidelines developed by the National Oceanic and Atmospheric Administration (NOAA). The ERM and PEL sediment quality guidelines are representative of the concentration at which harmful effects are likely. This method also uses studies done by Long and McDonald (1998) where the concentration of each constituent in a sample is divided by its respective ERM or PEL value resulting in an ERM-Q or PEL-Q value. The mean ERM-Q or PEL-Q value is then used to classify the sediment into four categories based on the probability of toxicity. Figure 4 shows the areas that are designated as a medium high risk (greater than 50% chance of amphipod toxicity) or high risk (greater than 74% chance of toxicity). Studies have shown a high correlation between the predicted probability of toxicity and the results obtained by toxicity testing. The results of this analysis are presented on Table 9-2 of the Final Tier 2 Remedial Investigation Report.

2. A comparison of sediment and water concentrations to the TCEQ first effect, midpoint, and second effect benchmarks was presented in the Final Tier 2 Remedial Investigation Report (Table 9-3). If a COPEC concentration exceeded the midpoint value then further action is indicated by this line of evidence.

3. A comparison of total PAH concentrations to total PAH benchmark values was the third line of evidence used. This method used the TCEQ (2006) approach of totaling the concentrations of thirteen individual PAHs to calculate a total PAH value. This value was compared to first effect, midpoint,

and second effect benchmarks. A Hazard Quotient (HQ) >1 for total PAH using the midpoint benchmark was used to identify areas with potential risk to benthic invertebrates from PAH toxicity.

4. The fourth method used was the ratio of the simultaneously extractable metals (SEM) and the acid volatile sulfides (AVS). If the ratio of the SEM divided by the AVS in sediment is less than 1, then the pore water toxicity of some metals is low. This method of analyzing metal bioavailability only applies to six metals including copper, lead, cadmium, nickel, zinc, and silver. Table 9-5 of the Final Tier 2 Remedial Investigation Report shows the result of this analysis.

5. The fifth method used evaluated PAHs and other non-ionic organic substances in sediment using the Toxic Unit approach. This method is described in EPA guidance (2003) and is based on the Target Lipid Model (Di Torro, 2000). Theoretically if a TU is > 1 then an adverse effect is likely to occur, however this method has an uncertainty factor of 2. Table 9-6 of the Final Tier 2 Remedial Investigation Report shows the result of this analysis.

There was a high correlation between the areas identified as unacceptable using the ERM-Q/PEL-Q method, and with the areas identified using the other lines of evidence. To simplify the sensitivity analysis and the Feasibility Study (FS), the results from the ERM-Q/ PEL-Q method were used to develop the Remedial Action Objectives (RAOs) and to establish the areas that need to be remediated due to risk to benthic invertebrates. Thirty of the seventy six sub-areas at the Site were categorized as a high or medium high risk to benthic invertebrates using the ERM-Q and PEL-Q method.

The sediment to fish pathway was evaluated by comparing COPEC concentrations in fish tissue to literature derived tissue residue data. Whole body tissue samples of fish that feed on benthic invertebrates were collected and analyzed. The COPECs determined to be a potential risk to fish include aluminum, barium, iron, copper, lead, manganese, chromium, zinc, endosulfan II, and total PAHs.

COPEC concentrations in freshwaters were compared with appropriate ecological benchmarks. The data indicated that aquatic invertebrates and fish would be exposed to concentrations that could pose risk. Data indicate that some metals, pesticides, PCBs and volatiles exceeded their applicable benchmark. When comparing COPEC concentrations in saltwater with appropriate ecological benchmarks, data indicated that aquatic invertebrates and fish would be exposed to concentrations that might indicate some risk. Data indicate that some metals, pesticides and volatiles exceeded their applicable benchmark.

To assess the risk to aquatic organisms exposed to COPECs at the Site, ecological benchmarks from TCEQ (2006) were compared to the arithmetic mean and RME of surface water chemistry results collected during the Tier 1 RI in 2006 and during the Tier 2 RI in 2009.

2006 Data: Thirty-two constituents, including eight metals, seven PCBs, eleven pesticides, three SVOCs, three PAHs and one VOC, had an HQ value greater than one based on ecological benchmark comparisons to either the arithmetic mean or RME in Tier 1 RI freshwater samples collected in 2006. In saltwater samples collected in 2006, 13 constituents, including four metals, eight pesticides, and two SVOCs, had an HQ value greater than one. The results of the arithmetic mean and RME-based ecological benchmark comparisons for 2006 surface water samples are summarized in Table 9-19 of the Final Tier Two Remedial investigation Report.

2009 Data: Twenty-five constituents, including five metals, seven PCBs, eight pesticides, three SVOCs, one PAH, and one VOC, had an HQ value greater than one based on ecological benchmark

comparisons to either the arithmetic mean or RME in freshwater samples from 2009. In saltwater samples collected in 2009, 14 constituents, including four metals, eight pesticides, and two SVOCs, had an HQ value greater than one based on ecological benchmark comparisons. The results of the arithmetic mean and RME-based ecological benchmark comparisons for 2009 surface water samples are summarized in Table 9-19.

Some contaminants can be stored in plant and animal tissue and this can result in a buildup of the contaminant in animals that are higher in the food chain. The tropic level of an organism is the position that it occupies in the food chain. A upper trophic level (UTL) receptor is typically a bird, mammal or fish that consumes smaller insects, fish or animals Risk to UTL receptors was evaluated using food chain exposure models that utilized site specific dietary and media COPEC concentrations. Site specific exposure values were used when available. Estimates of total daily dose were calculated for each UTL receptor-COPEC pair and divided by an effects concentration to generate a HQ. The calculated HQs are provided in Table 9-23 of the Final Tier 2 Remedial Investigation Report. Fifteen UTL receptors were used as measurement endpoints in the food chain evaluation.

Risk was defined as low (or acceptable) if the HQ[NOAEL] values are less than one. Risk was considered to be indeterminate if the HQ (NOAEL) >1 while the HQ(midpoint) and HQ(LOAEL) <1. Risk was considered probable if the HQ (midpoint) >1 and the HQ (LOAEL) <1. Risk was considered high if the HQ (LOAEL) >1 or if a threatened and endangered species has a HQ (NOAEL) >1. The COPEC exposures that were addressed in the FS and sensitivity analysis are those that resulted in an indeterminate, probable, or high risk.

Two VOCs, ethylbenzene and carbon disulfide, indicated indeterminate and probable risk to the Spotted Sandpiper and the Marsh Wren, respectively. Exposure levels in the remaining thirteen receptor models had acceptable risk for VOCs. Exposure models indicate high exposure risks from hexachlorobenzene to the Bullfrog, Painted Turtle, Mallard, Marsh Wren, Spotted Sandpiper, Raccoon, and the Short-Tailed Shrew. Pentachlorophenol had indeterminate exposure risks to the Spotted Sandpiper and high exposure risks to the Painted Turtle, Raccoon, and Short-Tailed Shrew. Benzaldehyde showed indeterminate exposure risk in the Belted Kingfisher model. PCBs evaluated as PCB congeners (∑TEQ PCB) had indeterminate exposure risk to the Short-Tailed Shrew and the Raccoon. Total PAHs were determined to be a high risk to the Short-Tailed Shrew and an indeterminate risk to the Raccoon and Muskrat. Endosulfan II and endrin pose probable risk to the Raccoon and indeterminate risk to the American Robin, respectively. Risks to all upper trophic level receptors with the exception of the Brown Pelican, Green Heron, and Reddish Egret, indicated general risk from exposure to metals Site-wide. The results of the exposure model assessment indicated that no COPEC exposure posed unacceptable risk to the state endangered Brown Pelican, state threatened Reddish Egret, and Green Heron. The state threatened Wood Stork, White-Faced Ibis, and Alligator Snapping Turtle (using the Painted Turtle as a surrogate) were found to be at potential risk from exposure to several COPECs. The dietary item (daily dose) that contributed the majority of risk for receptor-COPEC pairs with HQ > 1 was identified to determine if risk was being driven by a particular environmental medium (i.e. soil, sediment, surface water) or by a combination of lower trophic dietary items and ingestion of COPECs directly from the environment. Each receptor-COPEC pair with a HQ > 1 is discussed in the Tier 2 RI Report Table 9-27.

The Sensitivity Analysis was completed to assess the reduction in Site-wide risk to upper trophic level receptors that would occur given a variety of remediation scenarios in sediment and soil. Most of the scenarios in the sensitivity analysis assumed that areas designated as a medium high risk or high risk to benthic invertebrates would be addressed. The remediation scenarios evaluated a variety of remedial goals (RGs) as well as the sediment and soil locations that need to be addressed. The sensitivity analysis showed

that if all polygon areas with an ERM-Q/ PEL-Q score of 3 (medium high priority) or 4 (high priority), along with the Jefferson Canal spoil pile are remediated to the RG values presented in Table 1, then risk to upper trophic level receptors would be acceptable. In the Sensitivity Analysis this scenario was identified as "10B". Figure 4 shows the location of the sub-areas or polygons included in scenario 10B. Figures 5 to 11 show the individual polygons that need to be addressed.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) describe what the proposed site cleanup is expected to accomplish. RAOs have been developed for the seven areas to be addressed by the proposed remedy. The RAOs specify the media type, contaminants of concern (COCs), potential exposure routes, receptors, and remediation goals. In a proposed plan, remediation goals are considered preliminary remedial goals (PRGs). These proposed cleanup levels become the final contaminant-specific cleanup levels in the Record of Decision (ROD). A PRG establishes acceptable contaminant levels or range of levels for the exposure route. The PRG is developed during the RI/FS and is based on human health or ecological criteria established during the risk assessment or federal/state numeric standards considered by EPA to be Applicable or Relevant and Appropriate Requirements (ARARs). Standards that apply to a site but are not legally enforceable are treated as to-be-considered (TBC) standards for the Site.

Preliminary ARARs that provide numeric standards as PRGs for the Site are the Texas Water Quality Act regulations, Toxic Substances Control Act (TSCA), and Clean Water Act. The proposed remedy is consistent with The Texas Risk Reduction Program (TRRP). Remedial action objectives have been developed for the seven areas that will be addressed by EPA's proposed cleanup plan. The proposed RAOs are:

- Protect benthic invertebrates by reducing direct contact exposure with COCs in areas where sediment is designated as medium-high (3) or high priority (4) ecological risk using ERM-Q/PEL-Q method.
- Protect upper trophic level (UTL) receptors by reducing ingestion/direct contact with sediment concentrations in excess of RGs in areas where sediment is designated as medium-high (3) or high priority (4) ecological risk using ERM-Q/PEL-Q method.
- Protect UTL receptors by reducing exposure to COPECs concentrations in excess of RGs in soil from the Jefferson Canal Spoil Pile.

Table 1 lists the PRGs that have been established for this site and the contaminants of concern.

Table 1 Preliminary Remedial Goals (PRGs)

	Freshwater Sediment mg/kg (dry wt.)	Saltwater Sediment mg/kg (dry wt.)	Soil mg/kg (dry wt.)
Antimony	**1**	**0.075**	**1**
Arsenic	**4.895**	**4.1**	**5.9**
Cadmium	**0.495**	**0.6**	**32**
Chromium Total	**21.7**	**40.5**	**30**

Chromium VI	**2.71**	**0.25**	**37**
Copper	**15.8**	**17**	**15**
Lead	**17.9**	**23.4**	**15**
Mercury	**0.18**	**0.15**	**Nr[1]**
Selenium	**0.15**	**0.5**	**0.3**
Silver	**1**	**1**	**nr**
Vanadium	**25**	**28.5**	**50**
Zinc	**121**	**150**	**nr**
Dibenzofuran	**0.315**	**3.5**	**nr**
4,4'-DDE	**0.00316**	**0.00207**	**nr**
4,4'-DDT	**0.00416**	**0.00119**	**nr**
Dieldrin	**0.0019**	**0.000715**	**nr**
Endosulfan II	**0.007**	**0.007**	**0.00001**
Pentachlorophenol	**25**	**3.99**	**5**
Carbon disulfide	**0.06**	**0.06**	**0.941**
Ethylbenzene	**1.43**	**0.325**	**0.03**
Total PAH	**0.81**	**2.01**	**1**
Total PCBs (Aroclors)	**0.0598**	**0.0227**	**nr**

[1] Not Required – concentration in soil does not result in unacceptable risk.

SUMMARY OF ALTERNATIVES

Forty three preliminary remedial alternatives were evaluated as part of the Feasibility Study. The thirty nine alternatives that were retained for detailed analysis are described below.

Common Elements: All of the AOIs with the exception of the Jefferson Canal Spoil Pile contain sediment that needs to be addressed. Many of the alternatives that were evaluated in each AOI contain common elements. A general description of these elements is provided below.

1. **No Action:** Consideration of a No Action response is required by the *EPA Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA, 1988*). The No Action response has been included to provide a basis for the comparison of the remaining general response actions. Under this response, No Action would be taken to isolate, remove, treat, or contain COCs in the sediment or soil at the Site. COC-affected media would remain in place and the potential for continued migration of constituents would not be mitigated. Additionally, no controls would be implemented o prevent intrusive activities, such as benthic invertebrate burrowing into the affected sediment.

2. **Monitored Natural Recovery (MNR):** MNR is a response for COC-affected sediment that uses natural processes (i.e., degradation, transport of sediments) to contain, destroy, or reduce toxicity or the bioavailability of constituents. Multiple natural occurring processes may be optimized to isolate, degrade, and remove COCs from the benthic environment. MNR is a gradual process, with a recovery time of years to decades. MNR types include chemical/physical processes, biological processes, and physical processes. The chemical/physical transport process option optimizes the natural activities of sorption, desorption, dispersion, diffusion, dilution, volatilization, re-suspension, and transport. The timeframe for this process option varies with each activity, COC, and Site

condition. The biological degradation process option optimizes the natural attenuation of COCs by native aerobic or anaerobic bacteria. PCBs and pesticides may be dechlorinated, and PAHs, SVOCs, and VOCs may be partially or completely degraded. The physical burial process option optimizes natural sedimentation and deposition to bury the affected materials in place. Additional deposition of clean sediment into the environment may lead to natural placement of an isolation layer between COC-affected sediments and the water column.

3. Containment: Containment includes a range of options by which the pathway between constituents and the environment is interrupted by a physical barrier. This barrier eliminates direct contact between benthic invertebrates and constituent affected sediment and soil, and discourages constituent migration or prevents erosion of affected sediments and soil. Examples of containment techniques potentially appropriate for the Site include soil caps, clay caps, composite caps, armored caps, and erosion control mats. The soil cap process option is implemented by covering affected sediment or soil with clean top soil to isolate COCs from the surrounding environment. Soil caps are not impermeable, making them better suited for containment of COC affected soils in non-aquatic environments than for use in aquatic environments where migration of COCs to the water column, and benthic invertebrate burrowing, may not be sufficiently inhibited. The impermeable clay cap process option is implemented by covering affected sediment or soil with clean clay material to isolate COCs from the surrounding environment. When saturated, the impermeable caps form a continuous, impermeable barrier between constituent affected sediments and the water column. This option provides long-term protection of benthic invertebrates and the environment, and produces a new benthic habitat. In high water velocity settings, impermeable clay caps are resistant to erosion, and can additionally be reinforced by an armored cap. Impermeable clay caps can also be used for containment of soils in non-aquatic environments. Both armored caps and erosion control mats serve to reduce erosion and bioturbation. An armored cap consists of a layer of cobbles, pebbles, or other large material and prohibits disturbance by its ability to prevent burrowing by organisms, stabilize materials, and prevent erosion. An erosion control mat consists of a lightweight aggregate contained within a poly-mesh exterior, and can both prevent erosion and provide stable marsh habitat, where applicable. The composite cap process option consists of some combination of soil, clay, and optional stabilizing media or geotextile (synthetic fabric for additional stabilization) placed over sediments or soils to inhibit migration of impaired pore water and to discourage bioturbators such as burrowing invertebrates. Composite cap mixtures include the use of a variety of materials to form the stabilizing aggregate; bentonite clay, other clay particles, or polymers are used frequently. When compared to sand caps, composite caps may reduce the necessary cap thickness by more than 90 percent. The soil cap and pipe process option encloses the channel flow within a pipe designed to meet necessary hydraulic capacity. The impacted sediments no longer have contact with the flowing water and may be capped in place with a layer of soil or clay.

4. Removal and Disposal: The removal and disposal alternative involves extraction of the affected sediments or soils by excavation or dredge, followed by disposal of those materials at an appropriate off-Site facility. Several remedial alternatives include removal of approximately twelve inches of impacted soil or sediment in applicable sub-areas in each AOI. Twelve inches is considered the biologically active zone for the purpose of eliminating ecological risk to potential receptors. The excavation process involves the removal of affected sediments using standard heavy equipment, excavation attachments on a marsh buggy, or similar amphibious heavy equipment. Following excavation, constituent affected sediments can be disposed at an approved off-Site landfill. The current assumption is that heavy equipment will not be used for removal of material in the pipeline servitude areas in any AOI. The hydraulic dredge process option is an appropriate removal alternative

for sites involving underwater sediments with low accessibility. During hydraulic dredging a pump provides suction to move the sediment slurry through a pipeline to a land-based dewatering area. The dredged material can be disposed at an approved off-Site landfill, or contained on-Site.

Alternatives Selected for Detailed Analysis: Multiple alternatives were developed for each AOI. These alternatives were evaluated to select the one that is best suited for the AOI and that best satisfies the evaluation criteria. A more detailed explanation of each alternative can be found in Section 4 of the Final Feasibility Study Report. A summary of the alternatives is provided below.

Jefferson Canal AOI *(Polygons JC-2, JC-7, JC-13, JC-18, JC-19, Shown on Figure 5)*

Alternative 1:	No Action
Alternative 2a:	Soil Cap and Pipe Containment of JC-7; Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch soil cap; no pipeline servitude removal or containment.
Alternative 2b:	Soil Cap and Pipe Containment of JC-7; Partial 12-inch Removal/Disposal; and Containment with a 12-inch soil cap on area outside the pipeline servitude and 12-inch Erosion Control Mat on the pipeline servitude.
Alternative 2c:	Soil Cap and Pipe Containment of JC-7; Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch Armored Cap.
Alternative 2d:	Soil Cap and Pipe Containment of JC-7; Partial 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap on area outside the pipeline servitude and 12-inch Erosion Control Mat on the pipeline servitude.
Alternative 3a:	Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch soil cap.
Alternative 3b:	Partial 12-inch Removal/Disposal; and Containment with a 12-inch soil cap on area outside the pipeline servitude and 12-inch Erosion Control Mat on the pipeline servitude
Alternative 3c:	Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch Armored Cap.
Alternative 3d:	Partial 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap on area outside the pipeline servitude and 12-inch Erosion Control Mat on the pipeline servitude.

Jefferson Canal Spoil Pile AOI *(Polygons JCSP- 1 through JCSP-25, inclusive, and JC-8, JC-9, JC-10, and JC-11 Shown on Figure 6)*

Alternative 1:	No Action.
Alternative 2a:	Containment with a 2-foot Composite Cap.
Alternative 2b:	Removal/Disposal of mounds to grade; and Containment with a 2-foot Composite Cap.
Alternative 2c:	Partial Containment with a 2-foot Composite Cap.
Alternative 3a:	Partial 12-inch Removal/Disposal; Removal/Disposal of mounds to grade; and Containment with a 2-foot Composite Cap.
Alternative 3b:	Partial 12-inch Removal/Disposal; Removal/Disposal of mounds to grade; and Partial Containment with a 2-foot Composite Cap.

Former Star Lake AOI *(Polygons SLC-6, SLC-11 Shown on Figure 7)*

Alternative 1:	No Action.
Alternative 2a:	Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch Impermeable Cap (minimizes erosion).
Alternative 2b:	Partial 12-inch Removal/Disposal; and Containment with a 12-inch Impermeable Cap (minimizes erosion) on area outside the pipeline servitude; and 12-inch Erosion Control Mat and 12-inch Composite Cap on the pipeline servitude.
Alternative 3a:	Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch Composite Cap.
Alternative 3b:	Partial 12-inch Removal/Disposal; and Containment with a 12-inch Composite Cap on area outside the pipeline servitude; 12-inch Erosion Control Mat and 12-inch Composite Cap on the pipeline servitude.

Star Lake Canal AOI *(Polygons SL-6, SL-7, SL-9, SL-10 Shown on Figure 8)*

Alternative 1:	No Action.
Alternative 2:	12-inch Removal/Disposal; and Containment with a 12-inch Impermeable Cap (minimizes erosion).
Alternative 3:	12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.

Gulf States Utility Canal AOI *(Polygons GSUC-7 Shown on Figure 9)*

Alternative 1:	No Action.
Alternative 2:	Containment with a 12-inch Composite Cap.
Alternative 3:	12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.
Alternative 4:	12-inch Removal/Disposal.

Molasses Bayou Waterway AOI *(Polygons MB-10, MB-14, MB-18/MB-18R, MB-21, MB-24, MB-49, MB-52, MB-54, MB-60, MB-61 Shown on Figure 10)*

Alternative 1:	No Action.
Alternative 2a:	Monitored Natural Recovery.
Alternative 2b:	Monitored Natural Recovery *(Polygons MB-10, MB-14, MB-18/MB-18R, MB-49, MB-52, MB-54 MB-60)*; and 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap *(Polygons MB-21, MB-24,MB-61).*
Alternative 3:	12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap.

Molasses Bayou Wetland AOI *(Polygons MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, MB-63 Shown on Figure 11)*

Alternative 1:	No Action.
Alternative 2a:	Monitored Natural Recovery.
Alternative 2b:	Monitored Natural Recovery *(Polygons MB-51, MB-56, MB-58,MB-59)*; and Containment with a 12-inch Composite Cap *(Polygons MB-26, MB-62, MB-63).*

Alternative 2c:	Monitored Natural Recovery *(Polygons MB-51, MB-56, MB-58,MB-59)*; and 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap *(Polygons MB-26, MB-62, MB-63).*
Alternative 2d:	Monitored Natural Recovery *(Polygons MB-51, MB-56, MB-58,MB-59)*; and 12-inch Removal/Disposal *(Polygons MB-26, MB-62, MB-63).*
Alternative 3:	Containment with a 12-inch Composite Cap.
Alternative 4:	Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch Armored Cap.
Alternative 5:	Partial 12-inch Removal/Disposal.

EVALUATION OF ALTERNATIVES

The NCP, 40 CFR Part 300, requires EPA to evaluate remedial alternatives against nine criteria to determine which alternative is preferred. The first two criteria are referred to as the "Threshold Criteria." They are overall protection of human health and the environment, and compliance with ARARs. Response actions under CERCLA must satisfy the Threshold Criteria. The next five criteria are referred to as the "Balancing Criteria." They are long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness, implementability, and cost. These criteria represent a balance of trade-offs with regards to each alternative. The EPA applies these seven criteria during the Detailed Analysis of Alternatives phase of the Feasibility Study (FS) to identify the relative advantages and disadvantages of each alternative for decision-making. The remaining two criteria (community and state acceptance) are referred to as "Modifying Criteria". They are applied after EPA presents the preferred alternative and its rationale for such preference to the state, and subsequently to the public in the Proposed Plan. The nine evaluation criteria defined in the NCP are the following:

Threshold Criteria:

Overall Protection of Human Health and the Environment: Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls and/or institutional controls.

Compliance with Applicable or Relevant and Appropriate Requirements: Section 121 (d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4) and NCP §300.430(f)(1)(ii)(C).

Balancing Criteria:

Long-Term Effectiveness and Permanence: Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Reduction of Toxicity, Mobility, or Volume through Treatment: Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Short-Term Effectiveness: Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved. Included with this evaluation is an estimated of the natural resources to be consumed and increased emissions to be produced for each alternative.

Implementability: Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Cost: Cost includes estimated capital and annual operations and maintenance costs, as well as present value costs.

Modifying Criteria:

State/Support Agency Acceptance: This criterion considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

Community Acceptance: Community acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance. This criterion will be fully considered after the public comment period.

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents the comparative analysis of the remedial alternatives developed for each of the seven AOIs. The objective of the comparative analysis is to identify the advantages and disadvantages of each remedial alternative relative to one another within an AOI, and provide key information for use in determination of the selected remedy. The nine criteria discussed in detail in the earlier part of the Proposed Plan are used to compare the remedial alternatives for each AOI.

JEFFERSON CANAL COMPARATIVE ANALYSIS

Jefferson Canal Alternative 1:

1. **Technology and Process Option:** No Action.
2. **Summary:** No remedial action taken; therefore no reduction of exposure between benthic invertebrates and COCs.
3. **Overall Protection of Human Health and the Environment:** Alternative would not provide protection from COCs to the environment.
4. **Compliance with ARARs:** Not compliant with requirements because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** This alternative provides no reduction in toxicity, volume, or mobility of COCs.

7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.
9. **Cost:** $0

Jefferson Canal Alternative 2a:

1. **Technology and Process Option 2a**: Containment with Soil Cap and Pipe at JC-7; Partial 12-inch Removal/Disposal outside of pipeline servitude; and Partial Containment with a 12-inch soil cap outside of pipeline servitude. There will be no removal or containment within the pipeline servitude.
2. **Summary:** Containment with a Soil Cap and Pipe is feasible along specific portions of Jefferson Canal downstream from Hogaboom Road in the area of the polygon that corresponds to sample number JC-7. Partial 12-inch removal/disposal and partial containment with a 12-inch soil cap is applicable in the sub-areas associated with sample locations JC-2, JC-13, JC-18, and JC-19. The excavated material would be transported directly into trucks for removal from the Site. The pipeline servitudes will not be excavated or contained with this alternative.
3. **Overall Protection of Human Health and the Environment:** Pipe containment and soil cap at JC-7 will provide a barrier between benthic invertebrates and the COCs. Partial 12-inch removal and 12-inch soil cap at JC-2, JC-13, JC-18, and JC-19 will provide elimination of the COC-affected sediment and a permanent disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Partial containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. This alternative does not meet the threshold criterion of overall protection of environment for 6 percent of the polygons to be remediated because the COC affected material in the pipeline servitude (6 percent) area is not removed or contained.
4. **Compliance with ARARs:** Alternative provides a moderate level of long term effectiveness and permanence because COC affected sediments are permanently isolated, for areas outside the pipeline servitude.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderate level of long term effectiveness and permanence because COC affected sediments are permanently isolated, for areas outside the pipeline servitude.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments to areas outside the pipeline servitude. The pipe further isolates any remaining sediment. There is no reduction of toxicity, mobility, or volume for the pipeline servitude areas.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation, the time it takes to sandbag and dewater the area, excavate approximately one foot of sediment, lay geotextile or a thin layer of sand, set precast concrete pipe, backfill to grade, and vegetatively stabilize the canal. This remedial action of the alternative provides immediate relief from exposure to affected sediment upon implementation. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become suspended in the water column by the excavation process.
8. **Implementability:** Alternative has a high degree of implementability. Materials and equipment are readily available. During implementation, logistical considerations will include proper timing of water diversion during preparation and pipe placement, staging requirements for backfill and equipment, and development of an erosion control plan to keep COC affected sediment out of the waterway. A

hydraulic analysis will be conducted during the design to verify that the capacity of the pipe is adequate for current flow and will safely convey the design event.

9. **Cost:**

Base Implementation Cost:	$353,000
Remediation and Disposal Cost:	$1,066,000
Present worth Operation & Maintenance Cost:	$92,000
Estimated Total Cost:	$1,511,000

Jefferson Canal Alternative 2b

1. **Technology and Process Option 2b:** Containment with a Soil Cap and Pipe at JC-7; Partial 12-inch Removal/Disposal; and Containment with a 12-inch soil cap on area outside the pipeline servitude; and a 12-inch Erosion Control Mat on the pipeline servitude.
2. **Summary:** Containment with a Soil Cap and Pipe is feasible along specific portions of Jefferson Canal downstream from Hogaboom Road in the area of the polygon that corresponds to sample number JC-7. Partial 12-inch removal/disposal and partial containment with a 12-inch soil cap is applicable in the sub-areas associated with sample locations JC-2, JC-13, JC-18, and JC-19 outside the pipeline servitude. The pipeline servitude will be contained with a 12-inch erosion control mat. The excavated material would be transported directly into trucks for removal from the Site.
3. **Overall Protection of Human Health and the Environment:** Pipe containment and soil cap at JC-7 will provide a barrier between benthic invertebrates and the COCs. Partial 12-inch removal and a 12-inch soil cap at JC-2, JC-13, JC-18, and JC-19 will provide protection of the environment through the elimination of the COC-affected sediment and a permanent disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Partial containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. An erosion control mat inhibits the migration of COC affected sediment by reduction of erosion, additionally trapping sediments and organic debris for marsh establishment.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a high level of long term effectiveness and permanence because COC affected sediments are permanently isolated for areas outside the pipeline servitude. The lightweight aggregate clay within the erosion control mat will remain in place, stabilizing the sediment, and population by marsh plants will increase both effectiveness and permanence.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. The pipe further isolates any remaining sediment.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation, the time it takes to sandbag and dewater the area, excavate approximately one foot of sediment, lay geotextile or a thin layer of sand, set precast concrete pipe, backfill to grade, and vegetatively stabilize the canal, and lay the erosion control mat. This remedial action of the alternative provides immediate relief from exposure to affected sediment upon implementation. Once the sediment is removed and a 12-inch soil cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become suspended in the water column by the excavation process. Implementation of the erosion control mat alternative provides a highly effective barrier between COC affected sediments and wave action or other erosive forces.

8. **Implementability:** Alternative has a high degree of implementability. Materials and equipment are readily available. During implementation, logistical considerations will include proper timing of water diversion during preparation and pipe placement, staging requirements for backfill and equipment, and development of an erosion control plan to keep COC affected sediment out of the waterway. A hydraulic analysis will be conducted during the design to verify that the capacity of the pipe is adequate for current flow and will safely convey the design event. Additionally, the removed COC affected sediment must be dewatered and disposed at an authorized facility.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,073,000
Present worth Operation & Maintenance Cost	$92,000
Estimated Total Cost	$1,518,000

Jefferson Canal Alternative 2c

1. **Technology and Process Option 2c:** Containment with Soil Cap and Pipe at JC-7; Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch Armored Cap. There will be no removal or containment within the pipeline servitude.
2. **Summary:** Containment with a Soil Cap and Pipe is feasible along specific portions of Jefferson Canal downstream from Hogaboom Road in the area of the polygon that corresponds to sample number JC-7. Partial 12-inch removal/disposal and partial containment with a 12-inch armored cap is applicable in the sub-areas associated with sample locations JC-2, JC-13, JC-18, and JC-19. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because the COC affected sediments can be removed from the AOI. The pipeline servitudes will not be excavated or contained with this alternative, so 6 percent of the AOI will not be remediated.
3. **Overall Protection of Human Health and the Environment:** Pipe containment and soil cap at JC-7 will provide a barrier between benthic invertebrates and the COCs. Partial 12-inch removal and 12-inch armored cap at JC-2, JC-13, JC-18, and JC-19 will provide protection of the environment through the elimination of the COC-affected sediment and a permanent disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Partial containment with a 12-inch armored cap provides resistance from erosion. An armored cap does inhibit the migration of COC affected sediment by reduction of erosion. This alternative does not meet the threshold criterion of overall protection of environment for 6 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (6 percent) area is not removed or contained.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs for areas outside the pipeline servitude. The COC-affected material remaining in the pipeline servitude (6 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderate level of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude. There is a high level of long-term effectiveness for an armored cap because of the prevention and reduction of erosion.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments to areas outside the pipeline servitude. The pipe further isolates any remaining sediment. There is no reduction of toxicity, mobility, or volume for the pipeline servitude areas. An armored cap further reduces mobility through the prevention of erosion.

7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation, the time it takes to sandbag and dewater the area, excavate approximately one foot of sediment, lay geotextile or a thin layer of sand, set precast concrete pipe, backfill to grade, and vegetatively stabilize the canal. This alternative provides immediate relief from exposure to affected sediment upon implementation. Once the sediment is removed and a 12-inch armor cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. An armor caps ability to reduce erosion is effective immediately after installation. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process.
8. **Implementability:** Alternative has a high degree of implementability. Materials and equipment are readily available. During implementation, logistical considerations will include proper timing of water diversion during preparation and pipe placement, staging requirements for backfill and equipment, and development of an erosion control plan to keep COC affected sediment out of the waterway. A hydraulic analysis will be conducted during the design to verify that the capacity of the pipe is adequate for current flow and will safely convey the design event.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,278,000
Present worth Operation & Maintenance Cost	$92,000
Estimated Total Cost	$1,723,000

Jefferson Canal Alternative 2d

1. **Technology and Process Option 2d:** Containment with a Soil Cap and Pipe at JC-7; Partial 12-inch Removal/Disposal; and Containment with 12-inch Armored Cap on area outside the pipeline servitude; and a 12-inch Erosion Control Mat on the pipeline servitude
2. **Summary:** Containment with a Soil Cap and Pipe is feasible along specific portions of Jefferson Canal downstream from Hogaboom Road in the area of the polygon that corresponds to sample number JC-7. Partial 12-inch removal/disposal and partial containment with a 12-inch armored cap is applicable in the sub-areas associated with sample locations JC-2, JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The pipeline servitude will be contained with a 12-inch erosion control mat. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because COC affected sediments can be removed from the AOI.
3. **Overall Protection of Human Health and the Environment:** Pipe containment and soil cap at JC-7 will provide a barrier between benthic invertebrates and the COCs. Partial 12-inch removal and a 12-inch armored cap at JC-2, JC-13, JC-18, and JC-19 will provide protection of the environment through the elimination of the COC-affected sediment and a disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Partial containment with a 12-inch armored cap will restore the canal to its pre-excavation depth and provide resistance to erosion. An erosion control mat inhibits the migration of COC affected sediment by reduction of erosion, additionally trapping sediments and organic debris for marsh establishment.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Alternative has a high degree of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude. The armored cap provides erosion protection. The long term effectiveness of the

erosion control mat is high because the lightweight aggregate clay will remain in place, continuing to stabilize the sediment, population by marsh plants will effectiveness and permanence.

6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. The pipe further isolates any remaining sediment.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation, the time it takes to sandbag and dewater the area, excavate approximately one foot of sediment, lay geotextile or a thin layer of sand, set precast concrete pipe, backfill to grade, and stabilize the canal with vegetation. Following sediment removal and 12-inch armored cap placement, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process. Implementation of the erosion control mat alternative provides a highly effective barrier between COC affected sediments and wave action or other erosive forces.
8. **Implementability:** Alternative has a high degree of implementability. Materials and equipment are readily available. Logistic considerations include proper timing of water diversion during preparation and pipe placement, staging requirements for backfill and equipment, and development of an erosion control plan to keep COC affected sediment out of the waterway. A hydraulic analysis will be conducted during the design to verify that the capacity of the pipe is adequate for current flow and will safely convey the design event.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,285,000
Present worth Operation & Maintenance Cost	$92,000
Estimated Total Cost	$1,730,000

Jefferson Canal Alternative 3a

1. **Technology and Process Option 3a:** Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch soil cap. There will be no removal or containment within the pipeline servitude.
2. **Summary:** Partial 12-inch removal/disposal and partial containment with a 12-inch soil cap is applicable in the sub-areas associated with sample locations JC-2, JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because COC affected sediments can be removed from the AOI. The pipeline servitudes will not be excavated or contained with this alternative.
3. **Overall Protection of Human Health and the Environment:** The partial 12-inch removal and partial soil cap will provide protection of the environment through the elimination of the COC-affected sediment and a disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. The partial containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. This alternative will maintain the hydraulic capacity of the canal. This alternative does not meet the threshold criterion of overall protection of environment for 6 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (6 percent) area is not removed or contained.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs for areas outside the pipeline servitude. The COC-affected material remaining in the pipeline servitude (6 percent) area may not comply with ARARs for the Site.

5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderately high degree of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. There is no reduction of toxicity, mobility, or volume for the pipeline servitude areas.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation. Once the sediment is removed and a 12-inch soil cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process.
8. **Implementability:** Alternative has a high degree of implementability and will not require any diversion of the stream; however, it will require the removed sediment to be dewatered and transported to an appropriate disposal facility. Materials and equipment are also readily available for removal/disposal and a 12-inch soil cap.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$811,000
Present worth Operation & Maintenance Cost	$92,000
Estimated Total Cost	$1,256,000

Jefferson Canal Alternative 3b [PREFFERED ALTERNATIVE]

1. **Technology and Process Option 3b:** Partial 12-inch Removal/Disposal; and Containment with a 12-inch soil cap on area outside the pipeline servitude; and a 12-inch Erosion Control Mat on the pipeline servitude.
2. **Summary:** Partial 12-inch removal/disposal and partial containment with a 12-inch soil cap is applicable in the sub-areas associated with sample locations JC-2 , JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The pipeline servitude will be contained with a 12-inch erosion control mat. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because COC affected sediments can be removed from the AOI.
3. **Overall Protection of Human Health and the Environment:** Partial 12-inch removal and partial soil cap will provide reduction of the COC-affected sediment and a disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Partial containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. The erosion control mat reduces migration of COC affected sediment by reduction of erosion, and by additionally trapping sediments and organic debris for marsh establishment.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderately high degree of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude. Additionally the lightweight aggregate clay within the erosion control mat will remain in place, continuing to stabilize the sediment; population by marsh plants will increase both effectiveness and permanence.

6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** This alternative does not reduce toxicity of the COC affected sediments, however, through excavation, a 12-inch soil cap, and an erosion control mat, mobility is eliminated and volume is reduced.
7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation. Once the sediment is removed and a 12-inch soil cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process. Implementation of the erosion control mat alternative additionally provides a highly effective barrier between COC affected sediments and wave action or other erosive forces.
8. **Implementability:** Alternative has a high degree of implementability, and will not require any diversion of the stream; however, it will require the removed sediment to be dewatered and transported to an appropriate disposal facility. Materials and equipment are also readily available for removal/disposal and a 12-inch soil cap.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$818,000
Present worth Operation & Maintenance Cost	$92,000
Estimated Total Cost	$1,263,000

Jefferson Canal Alternative 3c

1. **Technology and Process Option 3c:** Partial 12-inch Removal/Disposal; and Partial Containment with a 12-inch Armored Cap. There will be no removal or containment within the pipeline servitude.
2. **Summary:** Partial 12-inch removal/disposal and partial containment with a 12-inch armored cap is applicable in the sub-areas associated with sample locations JC-2 , JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The excavated material would be transported directly into trucks for removal from the Site. The alternative is feasible because COC affected sediments can be removed from the AOI. The pipeline servitudes will not be excavated or contained with this alternative, so 6 percent of the AOI will not be remediated.
3. **Overall Protection of Human Health and the Environment:** Partial 12-inch removal and a partial armored cap will provide reduction of the COC-affected sediment and a permanent disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Partial containment with a 12-inch soil cap will restore the canal to its pre-excavation depth and provide a new benthic habitat to the areas outside the pipeline servitude. The armored cap reduces migration of COC affected sediment by reduction of erosion. This alternative does not meet the threshold criterion of overall protection of environment for 6 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (6 percent) area is not removed or contained.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs for areas outside the pipeline servitude. The COC-affected material remaining in the pipeline servitude (6 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** The long term effectiveness and permanence of this action is moderately high for 12-inch removal because this remedial action provides a permanent long term solution to exposure of COCs within the sediment for areas outside the pipeline servitude. There is a high level of long-term effectiveness for an armored cap because of the prevention and reduction of erosion.

6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The removal of sediment does not reduce toxicity of the COC affected sediments, however, mobility is eliminated and volume is reduced. There is no reduction of toxicity, mobility, or volume for the pipeline servitude areas. An armor cap reduces mobility through the prevention of erosion.
7. **Short-Term Effectiveness:** Implementation of the excavation portion of the alternative provides a highly effective short term solution to contact between benthic invertebrates and the COCs. Once the sediment is removed and a 12-inch armor cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. An armor caps ability to reduce erosion is effective immediately after installation. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process.
8. **Implementability:** The removal/disposal and containment of the areas outside the pipeline servitude is also highly implementable and will not require any diversion of the stream; however, it will require the removed sediment to be dewatered and transported to an appropriate disposal facility. Additionally, the removed COC affected sediment must be dewatered and disposed at an authorized facility. Materials and equipment are also readily available for removal/disposal and a 12-inch armor cap.
9. **Cost:**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,023,000
Present worth Operation & Maintenance Cost	$92,000
Estimated Total Cost	$1,468,000

Jefferson Canal Alternative 3d

1. **Technology and Process Option 3d:** Partial 12-inch Removal/Disposal; and Containment with a 12-inch Armored Cap on area outside the pipeline servitude; and a 12-inch Erosion Control Mat on the pipeline servitude.
2. **Summary:** Partial 12-inch removal/disposal and partial containment with a 12-inch armored cap is applicable in the sub-areas associated with sample locations JC-2, JC-7, JC-13, JC-18, and JC-19 outside the pipeline servitude. The pipeline servitude will be contained with a 12-inch erosion control mat. The excavated material would be transported directly into trucks for removal from the Site. This alternative is feasible because COC affected sediments can be removed from the AOI.
3. **Overall Protection of Human Health and the Environment:** Partial 12-inch removal and a partial armored cap will provide reduction of the COC-affected sediment and a disruption of the pathway between the potential receptors and the COCs to areas outside the pipeline servitude. Excavation will require the sediment to be dewatered (possibly treated) and disposed. Partial containment with a 12-inch armored cap will restore the canal to its pre-excavation depth and provide resistance to erosion. The erosion control mat reduces migration of COC affected sediment by reduction of erosion, and by additionally trapping sediments and organic debris for marsh establishment
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a high degree of long term effectiveness and permanence because COC affected sediments are isolated for areas outside the pipeline servitude. Additionally, armored cap and erosion control mat will each reduce erosion on the long term.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. The armor cap further reduces mobility through the prevention of

erosion. The erosion control mat does not reduce toxicity of the COC affected sediments, however, mobility is highly reduced.

7. **Short-Term Effectiveness:** Short term effectiveness depends upon the duration of implementation. Once the sediment is removed and a 12-inch armor cap is used for stabilization of the canal, the risk to benthic invertebrates from exposure to COC affected sediment is eliminated. The armor cap and erosion resistant mat will each reduce erosion immediately after installation. Additionally, care will be taken to install best management practices such as silt curtains to trap any affected sediment that may become re-suspended in the water column by the excavation process.
8. **Implementability:** Alternative has a high degree of implementability, and will not require any diversion of the stream; however, it will require the removed sediment to be dewatered and transported to an appropriate disposal facility. Additionally, the removed COC affected sediment must be dewatered and disposed at an authorized facility.
9. **Cost**

Base Implementation Cost	$353,000
Remediation and Disposal Cost	$1,030,000
Present worth Operation & Maintenance Cost	$92,000
Estimated Total Cost	$1,475,000

Jefferson Canal Preferred Alternative and Rationale for Selection: Alternative 3b is recommended over the other alternatives because this alternative is expected to achieve the greatest reduction of toxicity, mobility and volume. Alternative 3b is implementable and should achieve long-term and short-term effectiveness.

JEFFERSON CANAL SPOIL PILE COMPARATIVE ANALYSIS

Jefferson Canal Spoil Pile Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** No remedial action taken; therefore no reduction of exposure between benthic invertebrates and COCs.
3. **Overall Protection of Human Health and the Environment:** Alternative would not provide protection to potential receptors from COC affected soils.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected soils.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken. No delineation of the buried pipeline servitude will be required.
9. **Cost:** $0

Jefferson Canal Spoil Pile Alternative 2a

1. **Technology and Process Option:** Containment with a 2-foot Composite Cap.

2. **Summary:** Feasible because cap would isolate COC affected soils from potential receptors and prevent infiltration from rainwater and erosion from surface runoff.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection through isolation of the COC affected soils from the environment and potential receptors.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence because the estimated breakthrough of organic COCs is on the order of hundreds of years. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative provides no reduction in toxicity or volume. Mobility would be reduced.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate to high due to construction duration associated with cap installation. Isolation from COCs is effective immediately.
8. **Implementability:** The implementability for this alternative is moderate due to the possibility of interference with the buried pipelines. Implementability is reduced by the pipeline servitude which requires the cap to be installed in pieces. Implementability of installing a cap on the pipeline servitude will be determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$515,000
Remediation and Disposal Cost	$1,538,000
Present worth Operation & Maintenance Cost	$108,000
Estimated Total Cost	$2,161,000

<u>Jefferson Canal Spoil Pile Alternative 2b</u> [Preferred Alternative]

1. **Technology and Process Option:** Removal/disposal of mounds to grade and containment with a 2-foot Composite Cap over the entire area.
2. **Summary:** This alternative includes the removal of the mounds to grade with a 2-foot composite cap over the entire Jefferson Canal Spoil Pile. The composite cap will consist of 12-inches of topsoil and 12-inches of clay.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through isolation and removal of COC affected soil. The small insects and animals at the Site generally burrow less than 2-feet below the ground surface and the cap will minimize their access.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence because COC affected soil is removed from the site and the composite cap provides long term isolation of COCs. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity and volume is high within the excavated areas. The reduction of mobility is high because of installation of the cap.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate due to construction duration associated with soil removal. Removal of COCs is effective immediately.
8. **Implementability:** This alternative is feasible because the area is accessible for removal/disposal of the mounds to grade and for the installation of composite cap materials. However, the implementability is moderate due to the possibility of interference with the buried pipelines. The portion of the mound within the pipeline area will be removed with light equipment if it is determined during the Remedial Design that it can be done without compromising the integrity of the pipelines.

9. **Cost:**

Base Implementation Cost	$515,000
Remediation and Disposal Cost	$1,775,000
Present worth Operation & Maintenance Cost	$108,000
Estimated Total Cost	$2,398,000

Jefferson Canal Spoil Pile Alternative 2c

1. **Technology and Process Option:** Partial Containment with a 2-foot Composite Cap.
2. **Summary:** Feasible because cap would isolate COC affected soils outside of the pipeline servitude from potential receptors and prevent infiltration from rainwater and erosion from surface runoff.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through isolation from COC affected soil for the areas outside of the pipeline servitude. This alternative does not meet the threshold criterion of overall protection of environment for 24 percent of the sub-areas to be remediated because the COC- affected material in the pipeline servitude (24 percent) area is not removed or contained.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs applicable and relevant for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude (24 percent) area may not comply with ARARs for the site.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence for the areas outside of the pipeline servitude. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative provides no reduction in toxicity or volume. Mobility would be reduced for the areas outside of the pipeline servitude.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative, for areas outside of the pipeline servitude, is moderate to high due to construction duration associated with cap installation. Isolation from COCs is effective immediately.
8. **Implementability:** The implementability of this alternative is high, based on technical feasibility, and availability of services and materials. No COC affected soil will be excavated so there is no excavation, transportation, or disposal of soil for this alternative. The pipeline servitude will need to be delineated during the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$515,000
Remediation and Disposal Cost	$1,211,000
Present worth Operation & Maintenance Cost	$108,000
Estimated Total Cost	$1,834,000

Jefferson Canal Spoil Pile Alternative 3a

1. **Technology and Process Option:** Partial 12-inch removal/disposal, removal/disposal of mounds to grade, and containment with a 2-foot Composite Cap.
2. **Summary:** Feasible because the area is accessible for excavation/disposal of 12-inches of COC affected soils and for the installation of composite cap materials.

3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through isolation and removal of COC affected soil.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence because COC affected soil is removed from the site and the composite cap provides long term isolation of COCs. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity and volume is high within the excavated areas. The reduction of mobility is high because of installation of cap.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate due to construction duration associated with soil removal. Removal of COCs is effective immediately.
8. **Implementability:** The implementability for this alternative is moderate due to the possibility of interference with the buried pipelines. Implementability is reduced by the pipeline servitude which requires the cap to be installed in pieces. Implementability of installing a cap on the pipeline servitude will be determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$555,000
Remediation and Disposal Cost	$3,456,000
Present worth Operation & Maintenance Cost	$108,000
Estimated Total Cost	$4,119,000

Jefferson Canal Spoil Pile Alternative 3b

1. **Technology and Process Option:** Partial 12-inch removal/disposal, removal/disposal of mounds to grade, and partial containment with a 2-foot Composite Cap.
2. **Summary:** Feasible because the area is accessible for excavation/disposal of 12-inches of COC affected soils outside of the buried pipeline servitude and for the installation of composite cap materials also outside of the servitude.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through isolation and removal of COC affected soil outside of the buried pipeline servitude. This alternative does not meet the threshold criterion of overall protection of environment for 24 percent of the sub-areas to be remediated because the COC- affected material in the pipeline servitude (24 percent) area is not removed or contained.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs applicable and relevant for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude (24 percent) area may not comply with ARARs for the site.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a high level of long-term effectiveness and permanence outside of buried pipeline servitude because COC affected soil is removed from the site and the composite cap provides long term isolation of COCs. The cap will be anchored and stabilized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity and volume is high within the excavated areas. The reduction of mobility is high because of installation of cap for all areas outside of the buried pipeline servitude.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate, for all areas outside of the buried pipeline servitude, due to construction duration associated with soil removal and isolation of COCs from installation of cap.

8. **Implementability:** The implementability for this alternative is moderate to high based on technical feasibility and availability of materials for installation of cap. The pipeline servitude will need to be delineated during the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$555,000
Remediation and Disposal Cost	$3,158,000
Present worth Operation & Maintenance Cost	$108,000
Estimated Total Cost	$3,821,000

Jefferson Canal Spoil Pile Preferred Alternative and Rational for Alternative Selection:

Alternative 2b is recommended over the other alternatives because this alternative will achieve the key RAO goal of protecting upper trophic level receptors. This alternative achieves risk reduction by combining removal and containment of spoil pile soil.

FORMER STAR LAKE COMPARATIVE ANALYSIS

Former Star Lake Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** No remedial action taken; therefore no reduction of exposure between benthic invertebrates and COCs.
3. **Overall Protection of Human Health and the Environment:** Alternative would not provide protection to potential receptors from COC affected sediments.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** This alternative provides no reduction in toxicity, volume, or mobility of COCs.
7. **Short-Term Effectiveness**: The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.
9. **Cost:** $0

Former Star Lake Alternative 2a

1. **Technology and Process Option:** Partial 12-inch removal/disposal and partial containment with a 12-inch Impermeable Cap.
2. **Summary:** Removal/disposal and a 12-inch impermeable cap are applicable to areas outside the pipeline servitude. The COC affected sediment will be partially removed from Site and disposed in an appropriate off‑site waste facility. For Alternative 2a, the servitude will not be excavated or capped.
3. **Overall Protection of Human Health and the Environment:** Alternative provides a permanent disruption of the pathway between receptors and the COC effected sediment. Cap installation will restore the bottom of the Former Star Lake AOI to the pre-excavation depth. An impermeable cap provides a barrier between the benthic invertebrates and COC affected sediment, and resists erosion from an inundated drainage canal. Neither the hydraulic capacity nor the sediment topography of the canal will be modified by the cap design. This alternative does not meet the threshold criterion of

overall protection of environment for 13 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (13 percent) area is not removed or contained.

4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude (13 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderately high level of long-term effectiveness and permanence. For all areas outside of the pipeline servitude, the COCs will be isolated from the potential receptors and the area will be stabilized. Infiltration from rain events, erosion, and benthic invertebrate burrowing will be prevented by the cap and established vegetation.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces volume and eliminates mobility of COC affected sediment. Reduction of toxicity is dependent on ratio of soil removed and components of the impermeable cap. For Alternative 2a, the servitude will not be excavated or capped.
7. **Short-Term Effectiveness:** Alternative provides short term effectiveness for the protection of ecological receptors in correspondence to duration of implementation, and reduces risks associated with exposure to COCs for all areas outside of the pipeline servitude.
8. **Implementability:** Alternative is moderately to highly implementable. Materials and equipment are readily available. Implementability is reduced by the pipeline servitude, which will require the implementation area to be divided into multiple subsections, thus increasing fencing, staking, and other administrative controls.
9. **Cost:**

Base Implementation Cost	$362,000
Remediation and Disposal Cost	$4,665,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$5,210,000

<u>Former Star Lake Alternative 2b</u> [Preferred Alternative]

1. **Technology and Process Option:** Partial 12-inch removal/disposal, and containment with a 12-inch impermeable cap on area outside pipeline servitude. Inside the pipeline servitude, a 12-inch Erosion Control Mat or a 12-inch composite cap will be placed depending on whether the area is on the banks of the Star Lake Canal.
2. **Summary:** The 12-inch removal/disposal and containment with a 12-inch impermeable cap is applicable to areas outside the pipeline servitude. The removal/disposal will not be done within 25-feet of the pipelines. Containment with a 12-inch Erosion Control Mat is applicable to the pipeline servitude areas near the bank of the Star Lake Canal and a 12-inch Composite Cap is applicable to pipeline servitude areas not near the banks of the Star Lake Canal. All removed sediment will be de-watered and properly disposed off-site.
3. **Overall Protection of Human Health and the Environment:** Alternative will restore the area to its pre-excavation depth, provide a new benthic habitat, provide a barrier between the benthic invertebrates and COC affected sediment, and resist erosion from an inundated drainage canal. Within the servitude, an erosion control mat will protect the environment by partially inhibiting the migration of sediment by reduction of erosion, and by trapping sediments and organic debris for marsh establishment. The lightweight aggregate of the mat will allow it to lie atop existing sediment without sinking, highly reducing disruption.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, action, and location specific ARARs.

5. **Long-Term Effectiveness and Permanence:** Alternative provides a high level of long term effectiveness and permanence. For all areas outside of the pipeline servitude, COCs within the sediment will be isolated and stabilized. The lightweight aggregate clay of the erosion control mat will remain in place and population by marsh plants will increase both effectiveness and permanence.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces mobility and volume of COC affected sediments. Reduction of toxicity is dependent on ratio of soil removed. The impermeable cap will further isolate any remaining affected sediment, and reduce erosion.
7. **Short-Term Effectiveness:** Alternative provides short term effectiveness in correspondence with the duration of implementation, which consists of time for excavation, impermeable cap placement, and placement of the erosion control mat. Sediment erosion is immediately reduced, in a level or inclined setting; implementation causes only minimal disruption or re-suspension of sediments.
8. **Implementability:** Alternative is moderately implementable. Materials and equipment are readily available. The removed COC affected sediment must be dewatered and disposed at an authorized facility. Logistical considerations are few, including transportation of materials, and coordination of site access; no heavy equipment diversion of water, or dewatering of sediment is necessary. Implementability is reduced by the pipeline servitude which requires the cap to be installed in pieces. Implementability of work in pipeline servitude will be further evaluated in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$362,000
Remediation and Disposal Cost	$4,691,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$5,236,000

Former Star Lake Alternative 3a

1. **Technology and Process Option:** Partial 12-inch removal/disposal and partial containment with a 12-inch Composite Cap.
2. **Summary:** The removal/disposal and a 12-inch composite cap are applicable to areas outside the pipeline servitude. For Alternative 3a, the servitude will not be excavated or capped.
3. **Overall Protection of Human Health and the Environment:** Alternative provides permanent disruption of the pathway between receptors and the COC affected sediment. The sediment will be partially removed from Site and disposed in an appropriate off Site waste facility. A cap with 6 inches of clay and 6 inches of topsoil will be anchored and stabilized to replace excavated soil outside of the pipeline servitude. This alternative will be designed not to modify the hydraulic capacity of the Former Star Lake AOI. This alternative does not meet the threshold criterion of overall protection of environment for 13 percent of the sub-areas to be remediated because the COC affected material in the pipeline servitude (13 percent) area is not removed or contained.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs for the Site for areas outside the pipeline servitude. The COC affected material remaining in the pipeline servitude (13 percent) area may not comply with ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a moderate level of long term effectiveness and permanence. For all areas outside of the pipeline servitude, the COCs will be isolated from the receptors and the area will be stabilized. Bioturbation from benthic invertebrate burrowing and erosion from water movement will be reduced by the composite cap.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces volume and mobility of COC affected sediment. Reduction of toxicity is dependent on ratio of soil removed and components of the composite cap. For Alternative 3a, the servitude will not be excavated or capped.

7. **Short-Term Effectiveness:** Alternative provides short term effectiveness in correspondence with the duration of implementation, which consists of time for the partial 12-inch removal/disposal and placement of a 12-inch containment cap in all areas outside of the pipeline servitude.
8. **Implementability:** Alternative is moderately to highly implementable. Materials and equipment are readily available. Implementability is reduced by the pipeline servitude, which will require the implementation area to be divided into multiple subsections, thus increasing fencing, staking, and other administrative controls.
9. **Cost**

Base Implementation Cost	$362,000
Remediation and Disposal Cost	$4,868,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$5,413,000

Former Star Lake Alternative 3b

1. **Technology and Process Option:** Partial 12-inch removal/disposal and containment with a 12-inch Composite Cap on area outside pipeline servitude, and a 12-inch Erosion Control Mat and 12-inch Composite Cap on the pipeline servitude
2. **Summary:** The removal/disposal and containment with a 12-inch Composite Cap are applicable to areas outside the pipeline servitude. Containment with a 12-inch Erosion Control Mat is applicable to the pipeline servitude areas near the bank of the Star Lake Canal and a 12-inch Composite Cap is applicable to pipeline servitude areas not near the banks of the Star Lake Canal.
3. **Overall Protection of Human Health and the Environment:** Alternative provides a disruption of the pathway between the potential receptors and the COCs for areas outside the pipeline servitude. An erosion control mat will partially inhibit the migration of sediment by reduction of erosion, and by additionally trapping sediments and organic debris for marsh establishment. The lightweight aggregate allows the mat to lie atop existing sediment without sinking, highly reducing disruption.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Alternative provides a high level of long term effectiveness and permanence for all areas outside of the pipeline servitude. The lightweight aggregate clay of the erosion control mat will remain in place and population by marsh plants will increase both effectiveness and permanence.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Alternative reduces volume and mobility of COC affected sediments. Reduction of toxicity is dependent on ratio of soil removed and components of the composite cap.
7. **Short-Term Effectiveness:** Alternative provides a highly effective barrier between COC affected sediments and wave action or other erosive forces. The mat provides immediate reduction of sediment erosion in a level or inclined setting. Additionally, implementation causes only minimal disruption or re-suspension of sediments.
8. **Implementability:** Alternative is moderately implementable in the areas outside the pipeline servitude. Materials and equipment are readily available. The removed COC affected sediment must be dewatered and disposed at an authorized facility. The erosion control mat has a high degree of implementability, because materials are readily available and easily installed. Logistical considerations are few, including transportation of materials, and coordination of site access; no heavy equipment diversion of water, or dewatering of sediment is necessary. Implementability is reduced by the pipeline servitude which requires the cap to be installed in pieces. Implementability of work in pipeline servitude will be further evaluated in the Remedial Design phase.

9. **Cost:**

Base Implementation Cost	$362,000
Remediation and Disposal Cost	$4,894,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$5,439,000

Former Star Lake Preferred Alternative and Rational for Alternative Selection: Alternative 2b is recommended over the other alternatives because this alternative is expected to achieve the greatest reduction of toxicity, mobility and volume. It is implementable and should achieve long-term and short-term effectiveness.

STAR LAKE CANAL COMPARATIVE ANALYSIS

Star Lake Canal Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** No remedial action taken; therefore no reduction of exposure between benthic invertebrates and COCs.
3. **Overall Protection of Human Health and the Environment:** Alternative would not provide protection to potential receptors from COC affected sediments.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** This alternative provides no reduction in toxicity, volume, or mobility of COCs.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.
9. **Cost:** $0

Star Lake Canal Alternative 2 [Preferred Alternative]

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Impermeable Cap.
2. **Summary:** Feasible option for sub-areas corresponding to sample numbers SLC - 11 and SLC -6. Hydraulic excavation is the preferred removal technology. If sediment removal is determined to not be feasible during the Remedial Design, then a 12-inch impermeable cap will be installed on the pipeline servitude.
3. **Overall Protection of Human Health and the Environment:** This alternative provides protection of the environment through partial removal of the COC affected sediment. The pathway between benthic invertebrates and COCs is disrupted. The impermeable cap provides resistance to erosion and burrowing, and provides better isolation of the underlying chemicals that an armored cap.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** Provides a high level of long-term effectiveness and permanence. Pathway between benthic invertebrates and COCs is permanently disrupted. Bioturbation from benthic invertebrate burrowing is eliminated.

6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** No reduction of toxicity is achieved, however volume is reduced and mobility eliminated.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate due to construction duration associated with cap installation.
8. **Implementability:** Implementability of this alternative is moderately high. Standard excavation equipment and materials are readily available. Excavated sediment will require dewatering and disposal. Sediment and erosion controls will need to be in place to prevent any COC affected sediments from becoming re-suspended and entering the waterway. The hydraulic capacity of this canal will be maintain as pre-excavation and capping depths and a Section 10 permit will be required for working in a navigable waterway.
9. **Cost:**

Base Implementation Cost	$350,000
Remediation and Disposal Cost	$3,803,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$4,336,000

Star Lake Canal Alternative 3

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Armored Cap.
2. **Summary:** Feasible option for sub-areas corresponding to sample numbers SLC - 11 and SLC -6.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of the environment through partial removal of the COC affected sediment. Pathway between benthic invertebrates and COCs is disrupted. Armored cap provides resistance from erosion and some resistance to burrowing. Armored Cap does not provide a permanent barrier between benthic invertebrates and COC affected sediments.
4. **Compliance with ARARs:** This alternative can be designed to comply with chemical, action, and location specific ARARs.
5. **Long-Term Effectiveness and Permanence:** A moderately high level of effectiveness and permanence. Pathway between COC affected sediment and benthic invertebrates will be disrupted. The armored cap provides resistance to erosion and some resistance to benthic burrowing.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** No reduction of toxicity is achieved, however volume is reduced and mobility is continually inhibited.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is moderate to high because construction duration is not as long as the composite cap installation. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** Implementability of this alternative is moderately high. Standard excavation equipment and materials are readily available. Excavated sediment will require dewatering and disposal. Sediment and erosion controls will need to be in place to prevent any COC affected sediments from becoming re-suspended and entering the waterway. The hydraulic capacity of this canal will be maintained at the pre-excavation level. A Section 10 permit will be required for working in a navigable waterway. Implementability of work within the pipeline servitude will be further determined in the Remedial Design.
9. **Cost:**

Base Implementation Cost	$350,000
Remediation and Disposal Cost	$4,656,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$5,189,000

Star Lake Canal Preferred Alternative and Rational for Alternative Selection: Alternative 2 is recommended over the other alternatives because this alternative is expected to achieve the greatest reduction of toxicity, mobility and volume. It is implementable and should achieve long-term and short-term effectiveness. Removal of material over the pipeline servitude areas will be determined during the Remedial Design phase and if removal is not possible, the 12-inch Impermeable Cap or Erosion Control Mat will be installed on the pipeline servitude, and removal/disposal will be implemented.

GULF STATES UTILITY CANAL COMPARATIVE ANALYSIS

Gulf States Utility Canal Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** Not feasible because sediments pose an unacceptable risk to the benthic community.
3. **Overall Protection of Human Health and the Environment:** Would not provide protection of benthic invertebrates and the environment.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity is low because this alternative does not involve a treatment technology that reduces the presence of COCs.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.
9. **Cost:** $0

Gulf States Utility Canal Alternative 2 [Preferred Alternative]

1. **Technology and Process Option:** Containment with a Composite Cap.
2. **Summary:** Technology isolates COCs from the benthic environment on a long- and short-term basis. Typical estimated breakthrough of organic COCs is on the order of hundreds of years. A composite cap can be implemented using commercially available equipment and operators, and will be designed to not alter the hydraulic capacity of the canal. This alternative will be implemented for the Gulf State Utility Canal polygon that corresponds to sample number GSUC-7. Erosion control matting will be used to stabilize the canal embankment.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through (1) isolation of COCs, (2) control of risk to benthic health by eliminating contact with COCs, and (3) provision of an unaffected benthic habitat.
4. **Compliance with ARARs:** Can be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence because the estimated breakthrough of organic COCs is on the order of hundreds of years. Composite cap will be designed to have high resistance to erosion.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces mobility by providing a barrier between the constituent affected sediment and the environment. This alternative does not reduce toxicity or volume.

7. **Short-Term Effectiveness:** Short term effectiveness of the composite cap depends upon duration of implementation. This includes time for standard construction mobilization and staging of equipment, cap material placement, and stabilization of the area following cap installation.
8. **Implementability:** Moderately high level of implementability within the Gulf States Utility Canal. Materials, equipment, and technology are readily available. Timing is not critical because the canal is not continually inundated, and does not require any water diversion. The cap will serve to anchor the sediment, and erosion control matting will stabilize the embankment. Based on available information, there are no pipeline crossings in the area to be remediated. However, the location and depth of pipelines will be further determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$336,000
Remediation and Disposal Cost	$174,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$693,000

Gulf States Utility Canal Alternative 3

1. **Technology and Process Option:** 12-inch removal/disposal and containment with a 12-inch Armored Cap.
2. **Summary:** Technology permanently removes COC affected sediments from the benthic environment. Excavation and capping utilizes standard equipment, and will require significant advanced coordination. Armored cap will replace removed sediment, and be designed not to alter the hydraulic capacity of the canal.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment and creation of a new benthic habitat.
4. **Compliance with ARARs:** Can be designed to comply with chemical, location, and action-specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment and new erosion resistant benthic habitat.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume and mobility of COC affected sediment because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness of this alternative depends upon construction duration associated with sediment removal and armored cap placement. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** This alternative has moderate implementability within the Gulf States Utility Canal. Materials, equipment and technology are readily available. Timing is not critical because the canal is infrequently inundated with water and does not require water diversion. Removed sediment will be dewatered in a controlled manor and removed to an appropriate facility for permanent disposal. Implementability of work within or near the pipeline servitude will be further determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$339,000
Remediation and Disposal Cost	$735,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$1,257,000

Gulf States Utility Canal Alternative 4

1. **Technology and Process Option:** 12-inch removal/disposal.
2. **Summary:** Excavation removes COC affected sediments from the benthic environment. Excavation utilizes standard equipment, and will require significant advanced coordination.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment.
4. **Compliance with ARARs:** Can be designed to comply with chemical, location, and action-specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume and mobility of COC affected sediment because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness of this alternative depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC-affected sediments.
8. **Implementability:** Moderate level of implementability within the Gulf States Utility Canal. Materials, equipment and technology are readily available. Timing is not critical because the canal is infrequently inundated with water and does not require water diversion. Removed sediment will be dewatered in a controlled manor and removed to an appropriate facility for permanent disposal. Implementability of work within or near the pipeline servitude will be further determined in the Remedial Design phase.
9. **Cost:**

Base Implementation Cost	$339,000
Remediation and Disposal Cost	$483,000
Present worth Operation & Maintenance Cost	$183,000
Estimated Total Cost	$1,005,000

Gulf States Utility Canal Preferred Alternative and Rational for Alternative Selection:
Alternative 2 is recommended over the other alternatives because this alternative will achieve risk reduction by installation of a composite cap to prevent erosion of the soft canal bottom and will provide a new benthic habitat.

MOLASSES BAYOU WATERWAY COMPARATIVE ANALYSIS

Molasses Bayou Waterway Alternative 1

1. **Technology and Process Option:** No Action.
2. **Summary:** Not feasible because sediments pose an unacceptable risk to the benthic community.
3. **Overall Protection of Human Health and the Environment:** Would not provide protection of benthic invertebrates and the environment.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The No Action alternative does not reduce toxicity, mobility or volume of COCs.

7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** The No Action alternative does not require implementation or regulatory oversight.
9. **Cost:** $0

Molasses Bayou Waterway Alternative 2a

1. **Technology and Process Option:** Monitored Natural Recovery (MNR).
2. **Summary:** Technology reduces toxicity and bioavailability of COCs over time; multiple natural occurring processes are optimized to isolate, degrade, or remove COCs from the benthic environment. The decrease in COC bioavailability is monitored, and adjustments made as necessary. For alternative 2a, MNR includes Molasses Bayou Waterway sub-areas that correspond to sample numbers: MB-10, MB-14, MB-18/MB-18R, MB-21, MB-24, MB-49, MB-52, MB-54, MB-60, and MB-61.
3. **Overall Protection of Human Health and the Environment:** Protection of the environment depends upon the rate of naturally driven degradation and dispersion processes. Alternative may provide protection of benthic invertebrates and the environment through (1) reduction of the bioavailability of COCs, (2) naturally occurring isolation, dispersion, or degradation of the COCs, and (3) non-invasive treatment of the current benthic habitat.
4. **Compliance with ARARs:** Can be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Moderate effectiveness and permanence. Effectiveness is dependent on physical, chemical, and biological recovery processes. MNR provides a greater degree of effectiveness over time by slowly reducing the pathway between COCs and the environment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces the toxicity of COC affected sediments by optimizing the natural biological processes in Molasses Bayou to break down PAHs and PCBs. Mobility of heavy metals may be reduced over time as the metals sorb to clays present in the existing sediment.
7. **Short-Term Effectiveness:** Low short-term effectiveness, due to the time necessary for natural processes to reduce the volume and toxicity of COCs.
8. **Implementability:** High level of implementability within the Molasses Bayou Waterway because little action is taken to optimize the naturally occurring processes. Heavy equipment, difficult to maneuver in areas surrounding the bayou, is not necessary. Administrative responsibilities are minimal, consisting of those associated with a sampling program for long term monitoring.
9. **Cost:**

Base Implementation Cost	$360,000
Remediation and Disposal Cost	$660,000
Present worth Operation & Maintenance Cost	$434,000
Estimated Total Cost	$1,454,000

Molasses Bayou Waterway Alternative 2b [Preferred Alternative]

1. **Technology and Process Option:** MNR, 12-inch removal/disposal, and containment with a 12-inch armored cap.
2. **Summary:** Alternative 2b includes MNR for the Molasses Bayou Waterway sub-areas that correspond to sample numbers MB-10, MB-14, MB-18/MB-18R, MB-49, MB-52, MB-54, and MB-60; and 12-inch removal/disposal and containment with a 12-inch armored cap for the sub-areas that

correspond to sample numbers MB-24, MB-61, and MB-21. Best management practices will be used such as curtains to trap sediment that may become suspended during excavation and placement of the armored cap. The hydraulic capacity of the waterway will not be modified.

3. **Overall Protection of Human Health and the Environment:** The MNR portion of the alternative lowers the risk of interaction between benthic invertebrates and the sediment very gradually. Overall protection of the environment depends upon the rate of naturally driven degradation and dispersion processes. The removal/disposal and containment portion of the alternative, using armored cap, provides overall protection by isolation of COC-affected sediments from benthic invertebrates and the environment. This alternative will reduce erosion of the soft bayou sediments in the sub-areas where it is implemented, and provide a new benthic habitat.
4. **Compliance with ARARs:** Can be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** The MNR portion of the alternative provides a moderate level of long term effectiveness for the protection of ecological receptors and the reduction of risks associated with exposure to COCs. As natural processes occur over time, MNR provides a greater degree of effectiveness by slowly reducing the pathway between the COCs and the environment. The long-term effectiveness and permanence of removal, disposal, and an armor cap is high in the sub-areas where those actions are implemented. Excavation will interrupt the pathway between COC-affected sediments and receptors, and the migration of any remaining COCs would be continually inhibited by the placement of an armored cap.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The MNR alternative reduces the toxicity of COC-affected sediments by optimizing the natural biological processes in Molasses Bayou. The mobility of metals may be reduced over time as the metals sorb to clays present in the existing sediment. The current within Molasses Bayou Waterway is weak, thus reduction of sediment volume by dispersion or reduction of mobility by placement of new sediment would occur slowly. In the sub-areas where removal/disposal and containment is implemented toxicity may be reduced depending on the concentration per unit volume remaining in place; however, volume is reduced by the amount of sediment excavated from the Site. Mobility is also reduced by the use of an erosion resistant cap.
7. **Short-Term Effectiveness:** The MNR alternative provides a low level of short-term effectiveness since it depends upon the occurrence of natural processes over time. Short-term effectiveness of the removal and containment actions depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC-affected sediments.
8. **Implementability:** High level of implementability for MNR within the Molasses Bayou Waterway because little action is taken to optimize the naturally occurring processes. The removal/disposal and containment portion of the alternative has a low level of implementability within the Molasses Bayou Waterway. Removal requires a high degree of accessibility and generates a large volume of sediment for disposal. Heavy equipment access and the preparation of staging and dewatering areas will cause damage to portions of the shallow and narrow bayou as well as the adjacent wetlands. Transportation of cap materials requires a high degree of accessibility and there is no convenient location for staging of cap materials.

9. **Cost:**

Base Implementation Cost	$429,000
Remediation and Disposal Cost	$2,183,000
Present worth Operation & Maintenance Cost	$708,000
Estimated Total Cost	$3,320,000

Molasses Bayou Waterway Alternative 3

1. **Technology and Process Option:** 12-inch removal/disposal; and containment with a 12-inch armored cap.
2. **Summary:** Alternative includes 12-inch removal/disposal and containment with a 12-inch armored cap for the Molasses Bayou Waterway AOI for sub-areas that correspond to sample numbers MB-10, MB-14, MB-18/MB-18R, MB-21, MB-24, MB-49, MB-52, MB-54, MB-60, and MB-61.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment.
4. **Compliance with ARARs**: Can be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume of COC affected sediment, and reduction of mobility because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** Low level of implementability within the Molasses Bayou Waterway. Dredging and excavation both require a high degree of accessibility and generate a large volume of sediment for disposal. Heavy equipment access and the preparation of staging and dewatering areas may cause damage to portions of this shallow wetland. Administrative responsibilities would include permitting and coordination of off-site transportation for removed sediment and for the disturbance of wetlands.
9. **Cost:**

Base Implementation Cost	$570,000
Remediation and Disposal Cost	$4,015,000
Present worth Operation & Maintenance Cost	$1,127,000
Estimated Total Cost	$5,712,000

Molasses Bayou Waterway Preferred Alternative and Rational for Alternative Selection:
Alternative 2b is recommended over the other alternatives because this alternative provides greater reduction of toxicity, mobility and volume and provides greater short-term effectiveness than MNR alone.

MOLASSES BAYOU WETLAND COMPARATIVE ANALYSIS

Molasses Bayou Wetland Alternative 1

1. **Technology and Process Option:** Not applicable.
2. **Summary:** Not feasible because sediments pose an unacceptable risk to the benthic community.
3. **Overall Protection of Human Health and the Environment:** Would not provide protection of benthic invertebrates and the environment.
4. **Compliance with ARARs:** Not compliant because no remedial action has been taken.
5. **Long-Term Effectiveness and Permanence:** Alternative would provide a low level of long-term effectiveness and permanence because it would not result in any significant change in the risks associated with COC affected sediment.

6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduction of toxicity is low because this alternative does not involve a treatment technology that reduces the presence of COCs.
7. **Short-Term Effectiveness:** The short-term effectiveness of this alternative is not applicable since no actions are taken.
8. **Implementability:** Not applicable since no actions are taken.
9. **Cost:** $0

Molasses Bayou Wetland Alternatives 2a

1. **Technology and Process Option:** MNR.
2. **Summary:** Technology reduces toxicity and bioavailability of COCs over time; multiple natural occurring processes are optimized to isolate, degrade, or remove COCs from the benthic environment. The decrease in COC bioavailability is monitored. MRR would apply to sub-areas associated with the Molasses Bayou Wetland that correspond to sample numbers MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** Overall protection of the environment depends upon the rate of naturally driven degradation and dispersion processes. Alternative may provide protection of benthic invertebrates and the environment through (1) reduction of the bioavailability of COCs, (2) naturally occurring isolation, dispersion, or degradation of the COCs, and (3) non-invasive treatment of the current benthic habitat.
4. **Compliance with ARARs:** Can be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Moderate long-term effectiveness and permanence. Effectiveness dependent on physical, chemical, and biological recovery methods optimized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces toxicity of COC affected sediments by optimizing the natural biological processes in Molasses Bayou to break down PAHs and PCBs. Mobility of heavy metals may be reduced over time as the metals sorb to clays present in the existing sediment.
7. **Short-Term Effectiveness:** Low level of short-term effectiveness, due to the time necessary for natural processes to reduce the volume and toxicity of COCs.
8. **Implementability:** High level of implementability within the Molasses Bayou Wetland because little action is taken to optimize the naturally occurring processes. Heavy equipment, difficult to maneuver in areas surrounding the bayou, is not necessary. Administrative responsibilities are minimal, consisting of those associated with a 10 year sampling program for long term monitoring.
9. **Cost:**

Base Implementation Cost	$360,000
Remediation and Disposal Cost	$954,000
Present worth Operation & Maintenance Cost	$853,000
Estimated Total Cost	$2,167,000

Molasses Bayou Wetland Alternative 2b [Preferred Alternative]

1. **Technology and Process Option:** MNR and containment with a 12-inch composite cap.
2. **Summary:** Alternative 2b includes MNR for the Molasses Bayou Wetland sub-areas that correspond to sample numbers MB-51, MB-56, MB-58, and MB-59; and containment with a 12-inch composite cap for the sub-areas that correspond to sample numbers MB-26, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** The MNR portion of the alternative lowers the risk of interaction between benthic invertebrates and the sediment very gradually. The

composite cap portion of the alternative serves to protect the environment by isolation of COC affected sediments from benthic invertebrates and the environment within the sub-areas where it is implemented. The composite cap will reduce erosion of the soft bottom, and provide a new benthic habitat.

4. **Compliance with ARARs:** Alternative will be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** The MNR portion of the alternative provides a low level of initial effectiveness for reduction of risks. As natural processes occur over time, MNR provides a greater degree of effectiveness by slowly reducing the pathway between the COCs and the environment. The long-term effectiveness and permanence of a composite cap is high. The migration of COCs from erosion and bioturbation from the burrowing of benthic invertebrates will be continually inhibited in the sub-areas where a composite cap is implemented.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** The MNR portion of the alternative slowly reduces the toxicity of COC affected sediments by optimizing the natural biological processes. The mobility of heavy metals may be reduced over time as the metals sorb to clays present in the existing sediment. A composite cap will reduce the mobility of the constituents by providing a barrier between the affected sediment and the ecological system in the sub-areas where it is implemented.
7. **Short-Term Effectiveness:** The MNR portion has a low level of short-term effectiveness due to the time necessary for natural processes to reduce the volume and toxicity of COCs. MNR implementation provides no immediate protection of ecological receptors or reduction of risks; however, implementation does not cause any disturbance of the marsh or redistribution of COC-affected sediments as may occur with alternatives that are more active. Short-term effectiveness of the composite cap depends upon duration of implementation, including time for mobilization, staging of equipment and materials, and stabilization of the area following cap installation.
8. **Implementability:** The MNR portion has a high level of implementability within the Molasses Bayou Wetland because little action is required to optimize the naturally occurring processes, and heavy equipment, which is difficult to maneuver in the wetland, is not required. The containment portion has a low level of implementability because the wetland has a low degree of accessibility, which impedes delivery of cap materials and equipment. Delivery and operations will damage portions of the wetlands within the sub-areas where it is implemented. The cap must be anchored, but the loose sediment within the wetland is not conducive to accepted anchoring methods. No convenient location exists for staging of cap materials.
9. **Cost:**

Base Implementation Cost	$540,000
Remediation and Disposal Cost	$3,213,000
Present worth Operation & Maintenance Cost	$1,127,000
Estimated Total Cost	$4,880,000

<u>Molasses Bayou Wetland Alternatives 2c and 2d</u>

1. **Technology and Process Option:** MNR; 12-inch removal/disposal, and containment with a 12-inch Armored Cap.
2. **Summary:** Technology reduces toxicity and bioavailability of COCs over time; multiple natural occurring processes are optimized to isolate, degrade, or remove COCs from the benthic environment. The decrease in COC bioavailability is monitored, and adjustments made as necessary. The MNR portion will apply to sub-areas that correspond to sample numbers: MB-51, MB-56, MB-58, and MB-

59; and the 12-inch removal/disposal and containment portion with a 12-inch armored cap (Alternative 2c) for the sub-areas that correspond to sample numbers MB-26, MB-62, and MB-63.

3. **Overall Protection of Human Health and the Environment:** Overall protection of the environment depends upon the rate of naturally driven degradation and dispersion processes. Alternative may provide protection of benthic invertebrates and the environment through (1) reduction of the bioavailability of COCs, (2) naturally occurring isolation, dispersion, or degradation of the COCs, and (3) non-invasive treatment of the current benthic habitat.
4. **Compliance with ARARs:** Will be designed to comply with chemical, location , and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** Moderate long-term effectiveness and permanence. Effectiveness dependent on physical, chemical, and biological recovery methods optimized.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces toxicity of COC affected sediments by optimizing the natural biological processes in Molasses Bayou to break down PAHs and PCBs. Mobility of heavy metals may be reduced over time as the metals sorb to clays present in the existing sediment.
7. **Short-Term Effectiveness:** Low level of short-term effectiveness, due to the time necessary for natural processes to reduce the volume and toxicity of COCs.
8. **Implementability:** High level of implementability within the Molasses Bayou Wetland because little action is taken to optimize the naturally occurring processes. Heavy equipment, difficult to maneuver in areas surrounding the bayou, is not necessary except of the removal and containment portions**.**
9. **Cost – Alternative 2c**

Base Implementation Cost	$2,040,000
Remediation and Disposal Cost	$12,764,000
Present worth Operation & Maintenance Cost	$1,127,000
Estimated Total Cost	$15,931,000

12. **Cost – Alternative 2d**

Base Implementation Cost	$2,040,000
Remediation and Disposal Cost	$10,917,000
Present worth Operation & Maintenance Cost	$1,127,000
Estimated Total Cost	$14,084,000

Molasses Bayou Wetland Alternative 3

1. **Technology and Process Option:** Containment with a 12-inch composite cap (no excavation)**.**
2. **Summary:** Technology isolates COCs from the benthic environment. This alternative will be implemented within Molasses Bayou Wetland sub-areas that correspond to sample numbers MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** Alternative provides protection of benthic invertebrates and the environment through (1) isolation of COCs, (2) control of risk to benthic health by eliminating contact with COCs, and (3) provision of an unaffected benthic habitat.
4. **Compliance with ARARs:** Alternative will be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence because the estimated breakthrough of organic COCs is on the order of hundreds of years. Composite cap will be designed to have high resistance to erosion.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces mobility by providing a barrier between the constituent affected sediment and the environment. Toxicity and volume are not reduced with this alternative.

7. **Short-Term Effectiveness:** Short term effectiveness of the composite cap depends upon duration of implementation. This includes time for standard construction mobilization and staging of equipment, cap material placement, and stabilization of the area following cap installation.
8. **Implementability:** Low level of implementability within the Molasses Bayou Wetland. The wetland has a low degree of accessibility, which impedes delivery of cap materials and equipment. The cap must be anchored, but the loose sediment within the wetland is not conducive to accepted anchoring methods. No convenient location exists for staging of cap materials.
9. **Cost:**

Base Implementation Cost	$540,000
Remediation and Disposal Cost	$2,839,000
Present worth Operation & Maintenance Cost	$274,000
Estimated Total Cost	$3,653,000

Molasses Bayou Wetland Alternative 4

1. **Technology and Process Option:** Partial 12-inch removal/disposal and partial containment with a 12-inch Armored Cap.
2. **Summary:** This alternative will be implemented outside of the pipeline servitude within Molasses Bayou Wetland sub-areas that correspond to sample numbers MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment.
4. **Compliance with ARARs:** This alternative will be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume of COC affected sediment, and reduction of mobility because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness of this alternative depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** Low level of implementability within the Molasses Bayou Wetland. Dredging and excavation both require a high degree of accessibility and generate a large volume of sediment for disposal. Heavy equipment access and the preparation of staging and dewatering areas may cause damage to portions of this shallow wetland. Administrative responsibilities would include permitting and coordination of off-site transportation for removed sediment and for the disturbance of wetlands.
9. **Cost:**

Base Implementation Cost	$2,040,000
Remediation and Disposal Cost	$29,680,000
Present worth Operation & Maintenance Cost	$274,000
Estimated Total Cost	$31,994,000

Molasses Bayou Wetland Alternative 5

1. **Technology and Process Option:** Partial 12- inch removal/disposal.

2. **Summary:** This alternative will be implemented outside of the pipeline servitude within Molasses Bayou Wetland sub-areas that correspond to sample numbers MB-26, MB-51, MB-56, MB-58, MB-59, MB-62, and MB-63.
3. **Overall Protection of Human Health and the Environment:** Provides protection of benthic invertebrates and the environment through permanent removal of COC affected sediment.
4. **Compliance with ARARs:** Alternative will be designed to comply with chemical, location, and action specific ARARs for the Site.
5. **Long-Term Effectiveness and Permanence:** High level of long-term effectiveness and permanence through removal of COC affected sediment.
6. **Reduction of Toxicity, Mobility, or Volume through Treatment:** Reduces volume of COC affected sediment, and reduction of mobility because affected sediment is removed from the site, and no longer has the ability to migrate to water or other sediment.
7. **Short-Term Effectiveness:** Short-term effectiveness of this alternative depends upon construction duration associated with sediment removal. Removal of COCs is effective immediately, though the water column may carry COC affected sediments.
8. **Implementability:** Low level of implementability within the Molasses Bayou Wetland. Dredging and excavation both require a high degree of accessibility and generate a large volume of sediment for disposal. Heavy equipment access and the preparation of staging and dewatering areas may cause damage to portions of this shallow wetland.
9. **Cost:**

Base Implementation Cost	$2,040,000
Remediation and Disposal Cost	$24,893,000
Present worth Operation & Maintenance Cost	$274,000
Estimated Total Cost	$27,207,000

Molasses Bayou Wetland Preferred Alternative and Rational for Alternative Selection:
Alternative 2b is recommended over the other alternatives because this alternative provides protection of benthic invertebrates and upper trophic level receptors. In addition, this alternative will achieve risk reduction by combining MNR with capping of the wetland areas that are accessible from Molasses Bayou.

SUMMARY OF PREFERRED ALTERNATIVES

Jefferson Canal - Alternative 3b:	**$ 1,263,000**
Jefferson Canal Spoil Pile - Alternative 2b:	**$ 2,398,000**
Former Star Lake – Alternative 2b:	**$ 5,236,000**
Star Lake Canal – Alternative 2:	**$ 4,336,000**
Gulf States Utility Canal – Alternative 2:	**$ 693,000**
Molasses Bayou Waterway – Alternative 2b:	**$ 3,320,000**
Molasses Bayou Wetlands – Alternative 2b:	**$ 4,880,000**
Total Cost of Alternatives:	**$22,126,000.00**

SUMMARY OF THE PREFERRED ALTERNATIVES

The Preferred Alternatives include removal/disposal of contaminated materials followed by the use of containment to provide a barrier between contaminated material remaining and biological receptors (i.e., benthic invertebrates and upper trophic receptors), and take into account the current and reasonably anticipated future land use. Monitored natural recovery is also a part of the preferred alternatives. The Preferred Alternatives for each of the seven areas being addressed by this Proposed Plan:

- **Jefferson Canal**

  Alternative 3b - Partial 12-inch Removal/Disposal and Containment is the Preferred Alternative. All sub-areas of interest (JC-2, JC-7, JC-13, JC-18, and JC-19) will be excavated. Excavation activities within sub-areas with pipeline servitudes will maintain a 25 foot boundary to ensure pipeline security. This alternative is recommended because it will achieve the key Remedial Action Objectives (RAOs) of protecting benthic invertebrates and upper trophic receptors. This alternative will achieve risk reduction by excavating 12 inches of material from portions of Jefferson Canal. Following excavation, a 12-inch soil cap will be placed on areas outside of the pipeline servitude and a 12-inch erosion control mat will be placed on the pipeline servitude. The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria. The Preferred Alternative is selected over the other alternatives because expected to achieve the greatest reduction of toxicity, mobility and volume as well as being implementable and achieving short-term and long-term effectiveness.

- **Jefferson Canal Spoil Pile**

  Alternative 2b - Removal/Disposal of mounds to grade and Containment with two-foot composite cap is the Preferred Alternative. Cap composition will consist of a 12-inch layer of clay to inhibit infiltration, overlaid with a 12-inch layer of top soil to allow for vegetative stabilization. This alternative is recommended because it will achieve the key RAO of protecting upper trophic receptors. The COCs are likely to be limited to less than the top 3 inches of soil or sediment and therefore the12-inch removal/disposal action will cut off the exposure pathway between the benthic invertebrates /upper trophic receptors and sediments/ soil containing the COCs. This alternative will achieve risk reduction by removal and disposal of soil pile mounds to grade and then containment with a composite cap to interrupt the exposure pathway between soil contaminants and upper trophic receptors. The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria. The Preferred Alternative is selected over the other alternatives because it is expected to achieve long-term protectiveness and the greatest reduction of mobility and volume as well as achieving short-term effectiveness and being implementable.

- **Former Star Lake**

  Alternative 2b - Partial 12-inch Removal/Disposal and Containment is the Preferred Alternative. This alternative is recommended because it will achieve the key RAOs of protecting benthic invertebrates and upper trophic receptors. This alternative will achieve risk reduction by the excavation of material from portions of the Former Star Lake. Following excavation, an impermeable clay cap will be placed on area outside the pipeline servitude. Inside the pipeline servitude, a 12-inch erosion control mat or a 12-inch composite cap will be placed depending on whether the area is on the banks of Star Lake Canal. The hydraulic capacity of the former lake will not be modified. The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria. The Preferred

Alternative is selected over the other alternatives because it is expected to achieve long-term protectiveness and the greatest reduction of toxicity, mobility and volume as well as achieving short-term effectiveness and being implementable.

- **Star Lake Canal**

Alternative 2 - Removal/Disposal and 12-inch Impermeable Cap is the Preferred Alternative. This alternative is recommended because it will achieve the key RAOs of protecting benthic invertebrates and upper trophic receptors. This alternative will achieve risk reduction by the excavation of portions of Star Lake Canal. Following excavation, a 12-inch impermeable cap will be placed to provide a barrier between contaminated sediment and benthic invertebrates. The hydraulic capacity of the canal will not be modified. The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria. The Preferred Alternative is selected over the other alternatives because it is expected to achieve the greatest long-term and short-term protectiveness and the greatest reduction of, mobility and volume as well as being implementable.

- **Gulf States Utility Canal**

Alternative 2 - Containment 12-inch Composite Cap is the Preferred Alternative. This alternative is recommended because it will achieve the key RAOs of protecting benthic invertebrates and upper trophic receptors. This alternative will achieve risk reduction by the installation of a composite cap to prevent erosion of the soft canal bottom and provide a new benthic habitat. The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria. The Preferred Alternative is selected over the other alternatives because it is expected to achieve long-term and short-term protectiveness, provides a reduction of mobility and volume, and is implementable.

- **Molasses Bayou Waterway**

- **Alternative 2b - Monitored Natural Recovery (MNR); 12-inch Removal/Disposal; and 12-inch Armored Cap is the Preferred Alternative.** This alternative is recommended because it will achieve the key RAOs of protecting benthic invertebrates and upper trophic receptors. This alternative will achieve risk reduction by combining MNR with removal, disposal and capping of the waterways that are accessible by the Star Lake Canal. The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria. The Preferred Alternative is selected over the other alternatives because it achieves greater long-term and short-term protectiveness than MNR alone, provides a reduction of toxicity, mobility and volume, and has greater implementability over removal/disposal of material that is inaccessible from Molasses Bayou.

- **Molasses Bayou Wetland**

Alternative 2b - Monitored Natural Recovery (MNR) and 12-inch Composite Cap is the Preferred Alternative. This alternative is recommended because it will achieve the key RAOs of protecting benthic invertebrates and upper trophic receptors. This alternative will achieve risk reduction by combining MNR with capping of the wetland areas that are accessible by the Star Lake Canal. The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria. The Preferred Alternative is selected over the other alternatives because it achieves greater long-term and short-term protectiveness than MNR alone, provides a reduction of toxicity, mobility and volume, and has greater implementability over removal/disposal of material that is inaccessible from Molasses Bayou.

Based on the information available at this time, EPA and TCEQ believe the Preferred Alternatives presented above would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would use permanent solutions to the maximum extent practicable. The Preferred Alternatives can change in response to public comment or new information.

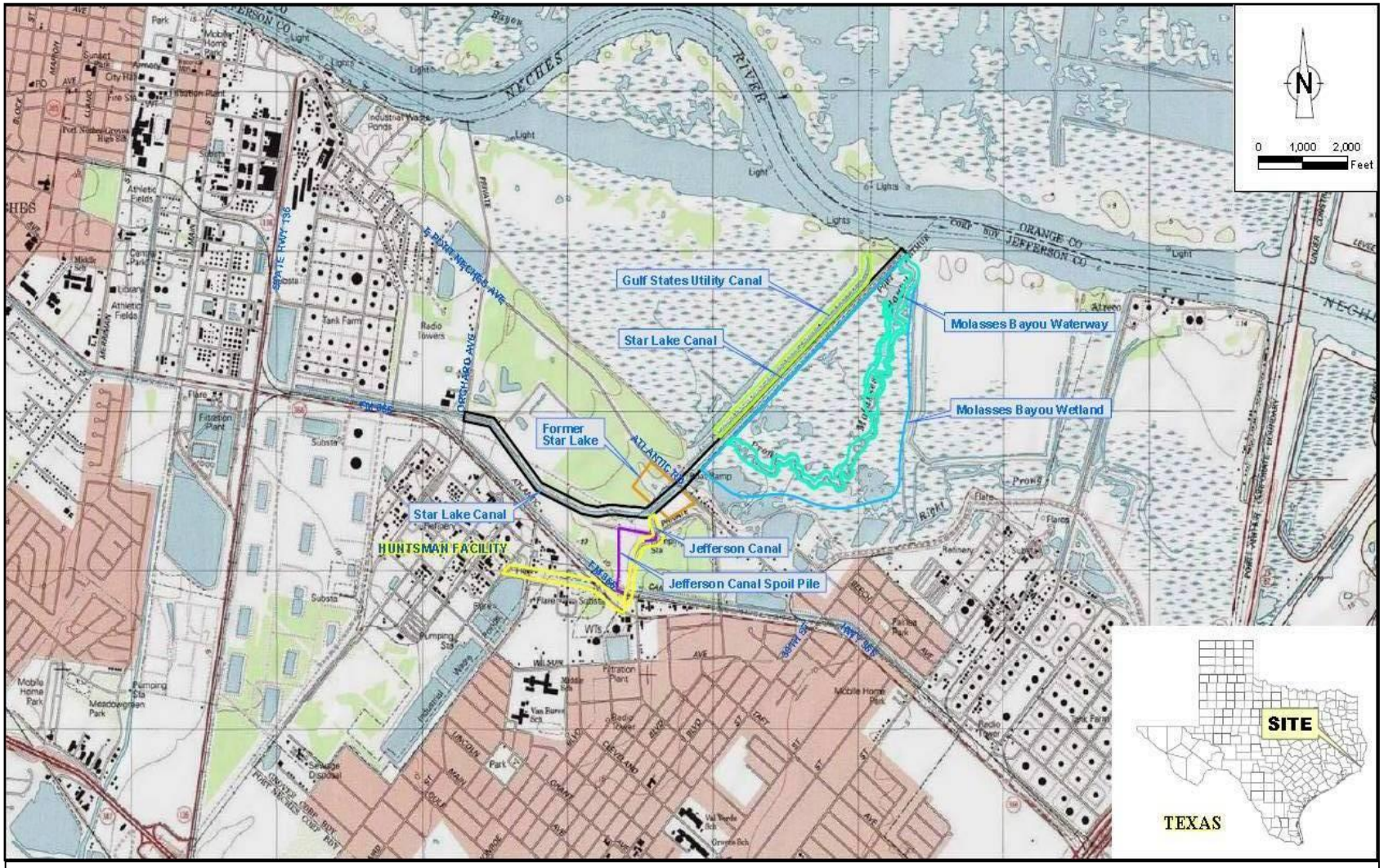


Figure 1 **Area Map, Star Lake Canal Superfund Site, Jefferson County, Texas**

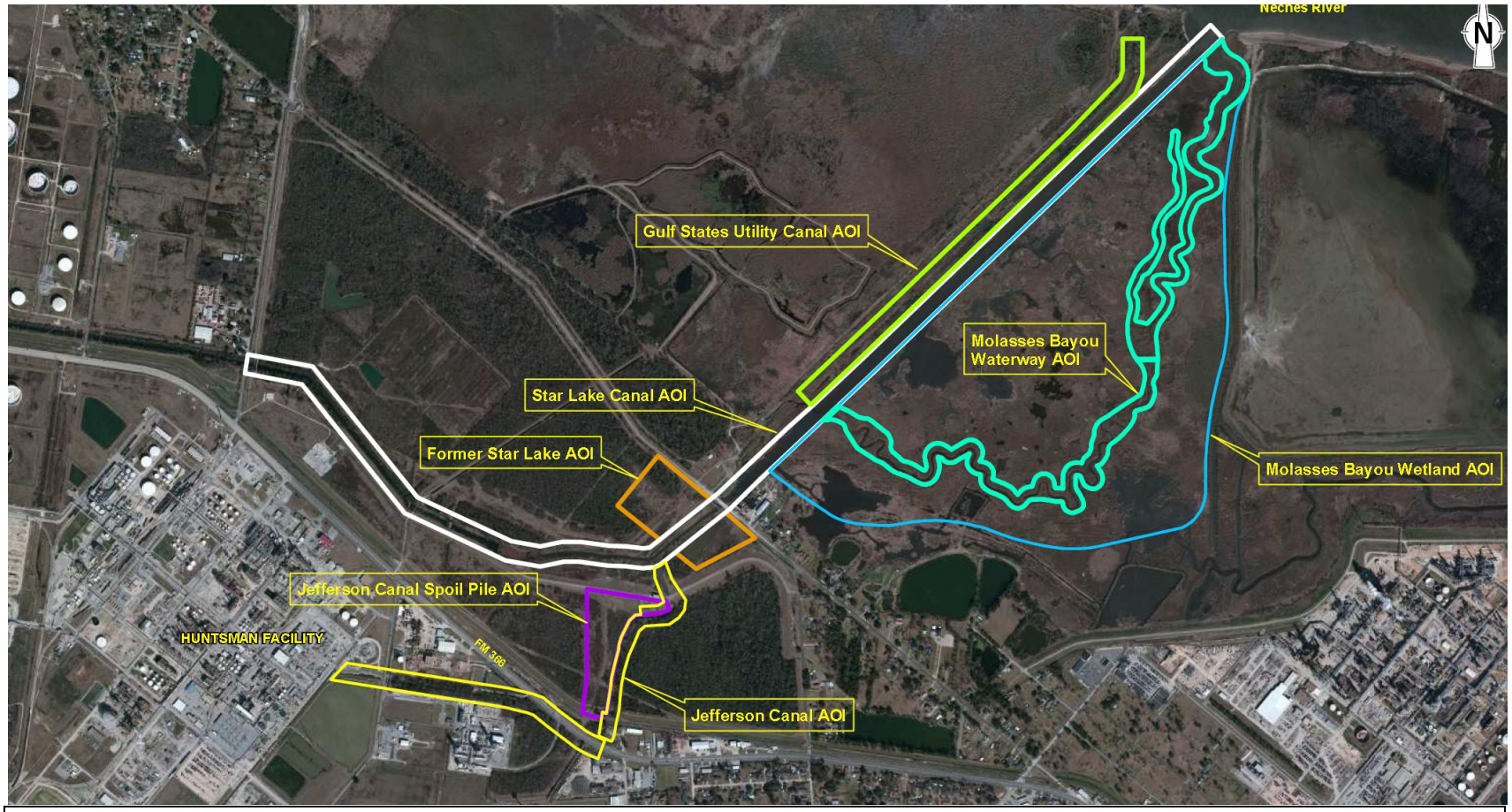


Figure 2 **Areas of Investigation, Star Lake Canal Superfund Site, Jefferson County, Texas**

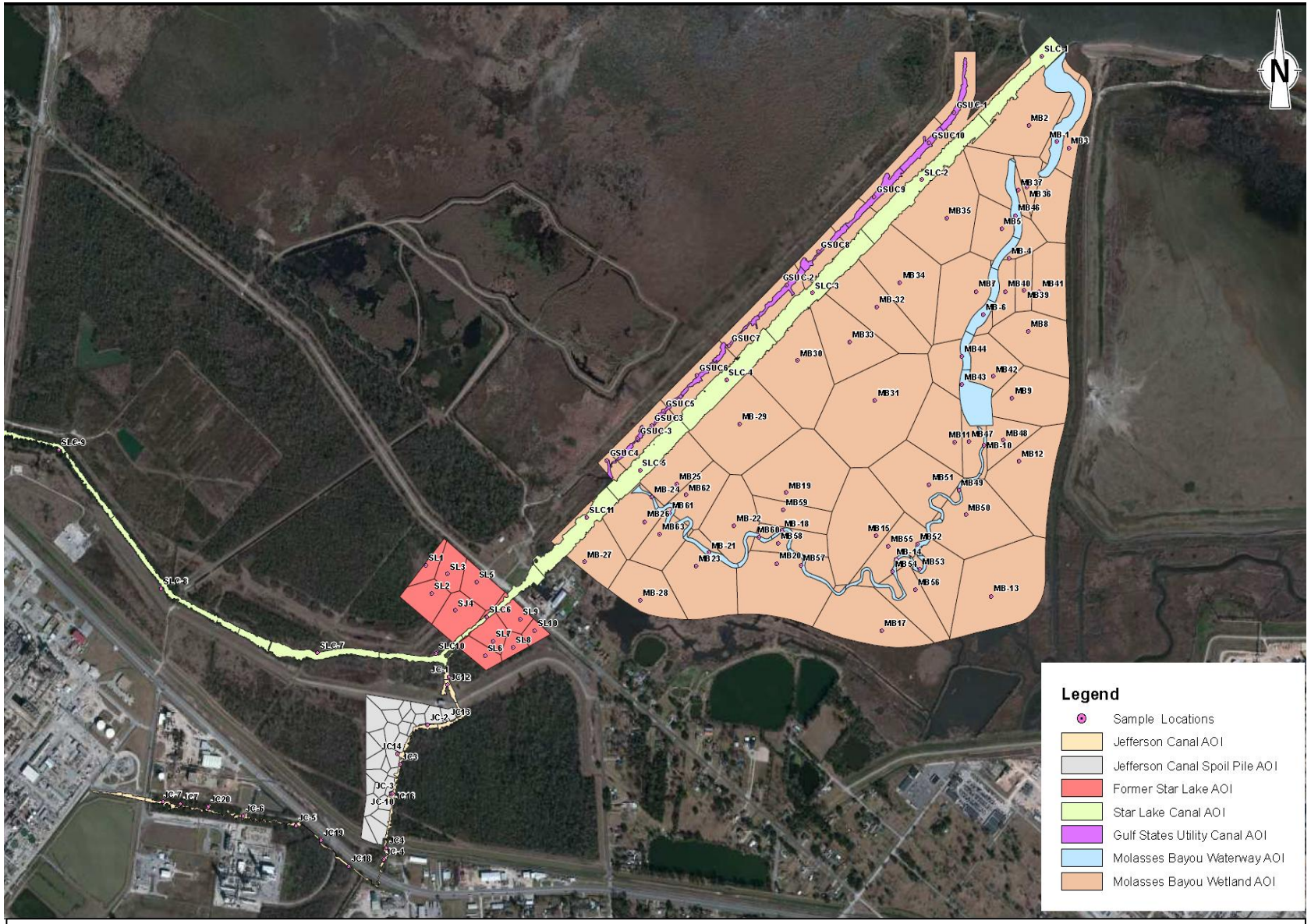


Figure 3 **Thiessen Polygons, Star Lake Canal Superfund Site, Jefferson County, Texas**

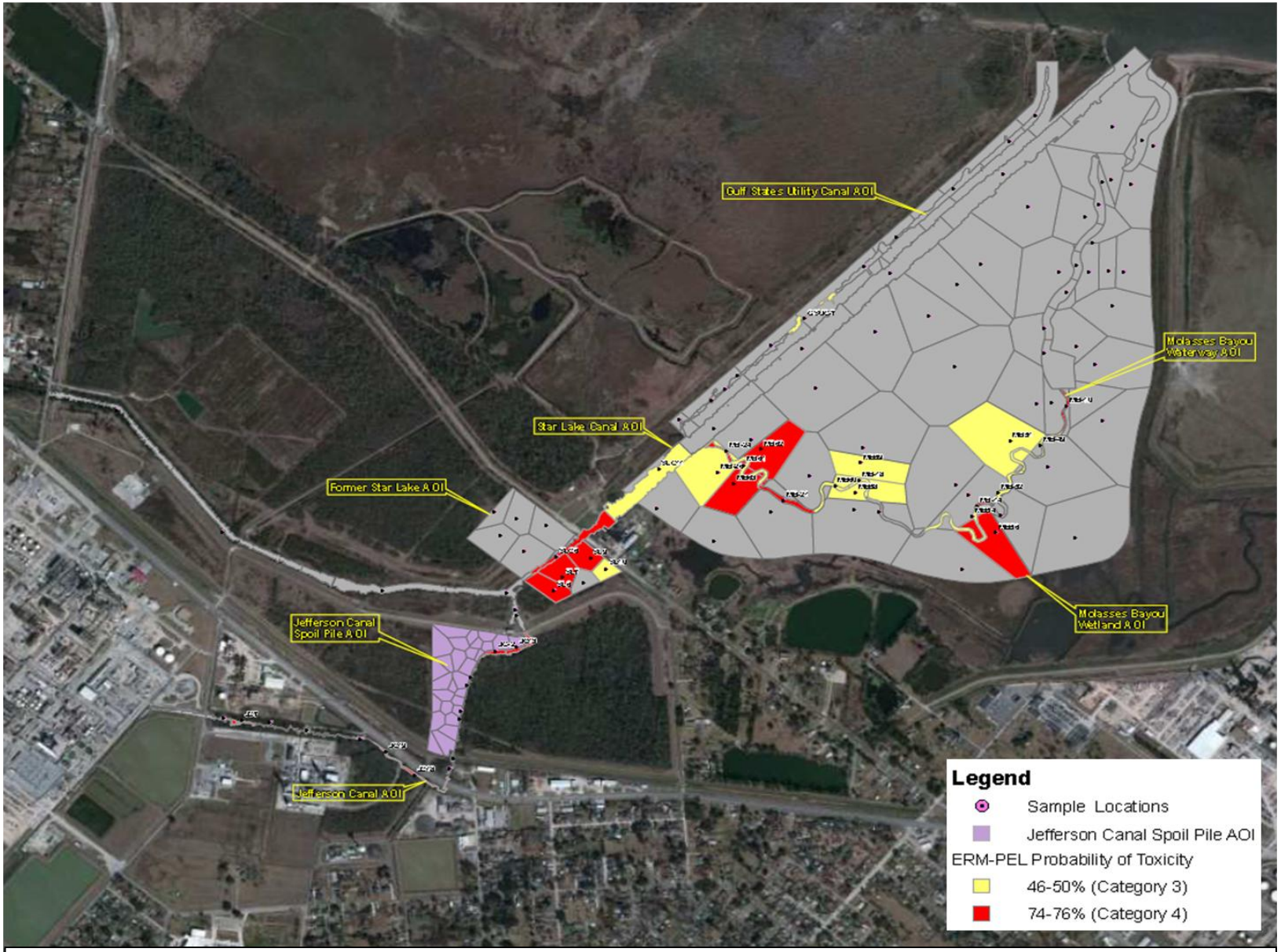
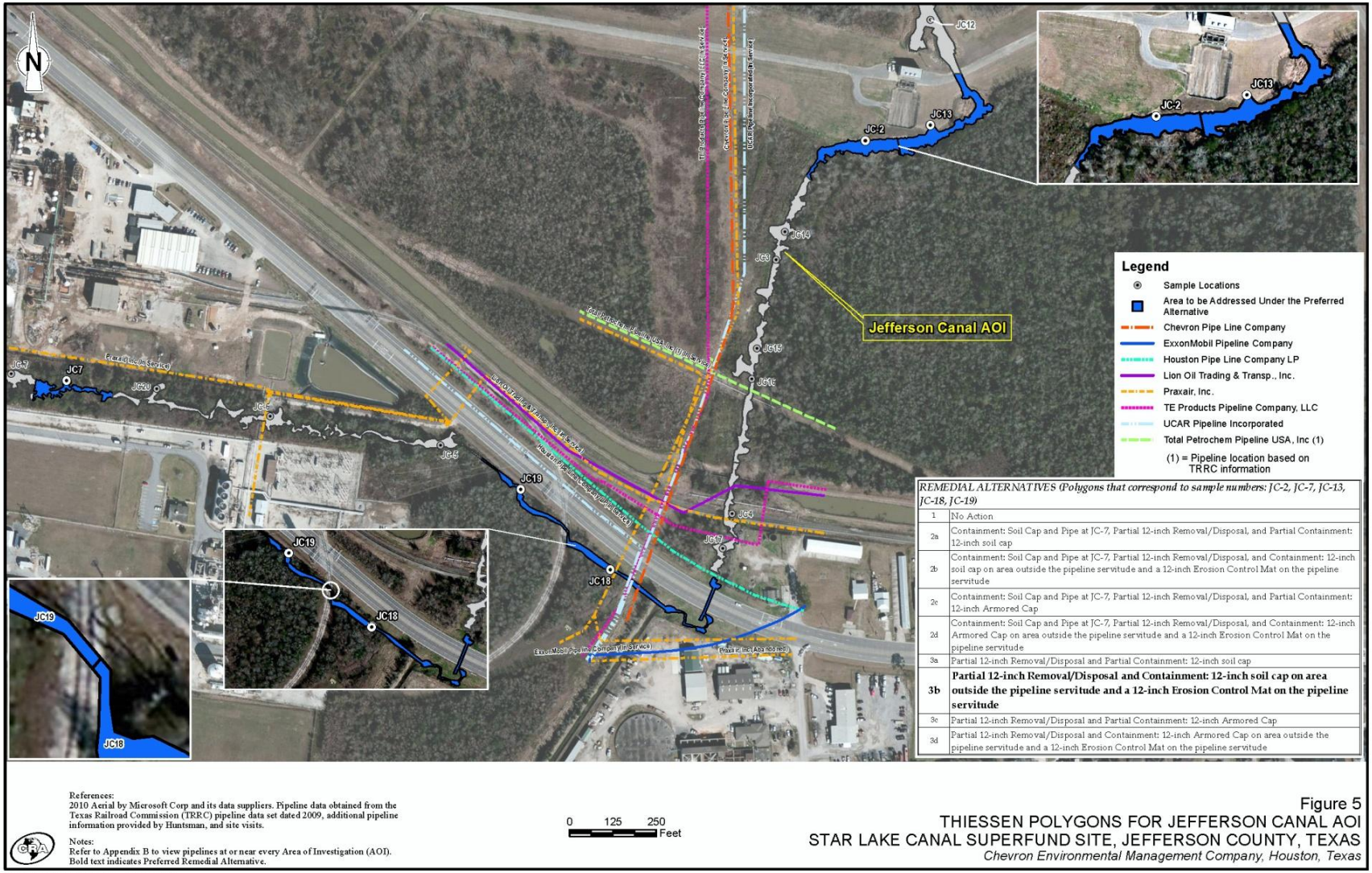
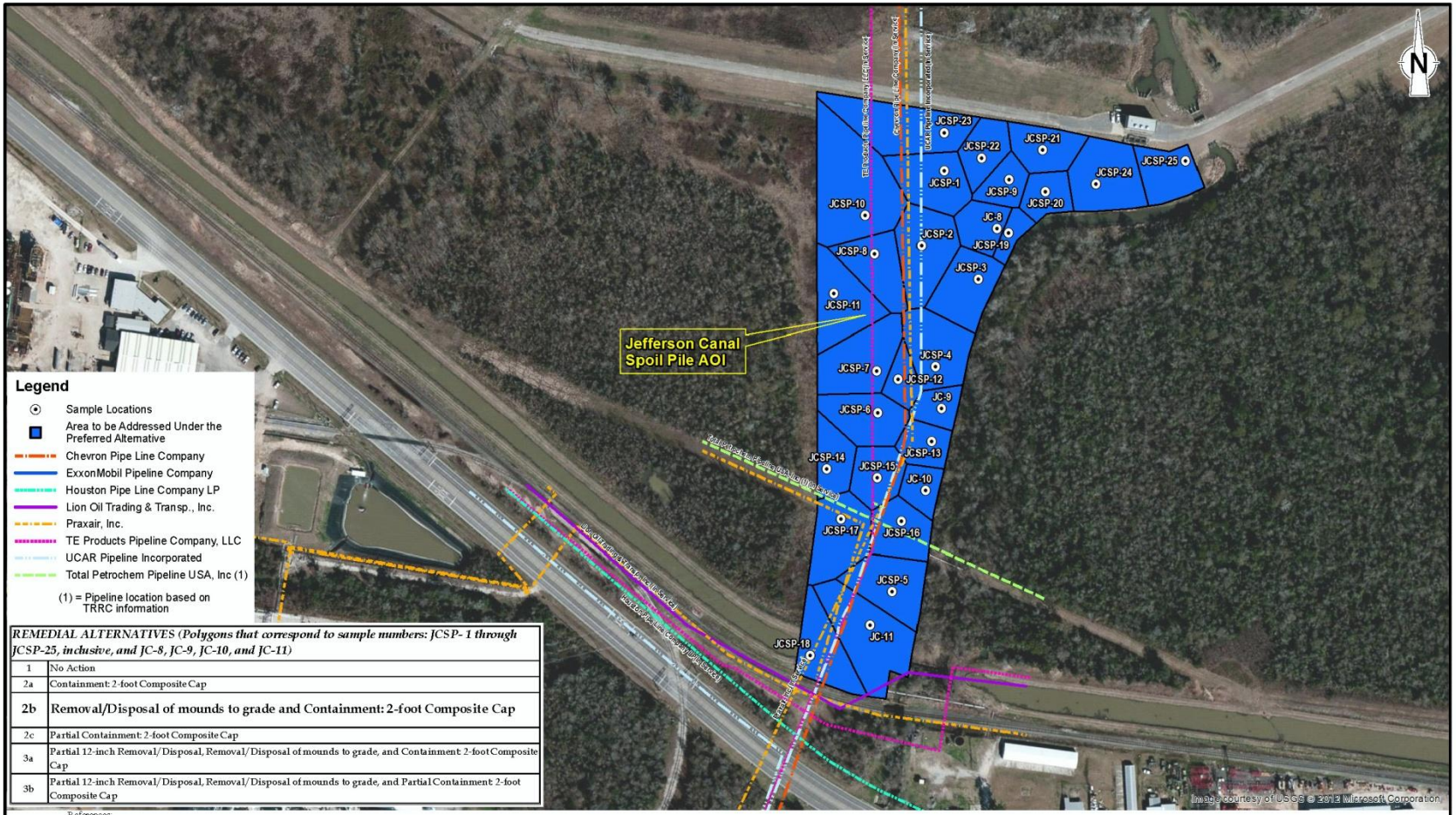


Figure 4 **Thiessen Polygons Included in Scenario 10B**



27545-00(019)PR-BR022 12/20/2012

Figure 5
THIESSEN POLYGONS FOR JEFFERSON CANAL AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas



REMEDIAL ALTERNATIVES (Polygons that correspond to sample numbers: JCSP- 1 through JCSP-25, inclusive, and JC-8, JC-9, JC-10, and JC-11)

1	No Action
2a	Containment: 2-foot Composite Cap
2b	**Removal/Disposal of mounds to grade and Containment: 2-foot Composite Cap**
2c	Partial Containment: 2-foot Composite Cap
3a	Partial 12-inch Removal/Disposal, Removal/Disposal of mounds to grade, and Containment: 2-foot Composite Cap
3b	Partial 12-inch Removal/Disposal, Removal/Disposal of mounds to grade, and Partial Containment: 2-foot Composite Cap

References:
2010 Aerial by Microsoft Corp and its data suppliers. Pipeline data obtained from the Texas Railroad Commission (TRRC) pipeline data set dated 2009, additional pipeline information provided by Huntsman, and site visits.

Notes:
Refer to Appendix B to view pipelines at or near every Area of Investigation (AOI).
The TRRC pipeline data set dated 2009 showed 3 additional pipelines (2 Total Petrochem Pipeline USA, Inc. pipelines and 1 Air Products, LLC pipeline) that extend east to west through the northern portion of the Jefferson Canal Spoil Pile AOI. However, Hunstman confirmed that these pipelines do not exist at these locations on Site and these 3 pipelines are not shown on this map.
Bold text indicates Preferred Remedial Alternative.

0 100 200 Feet

Figure 6
THIESSEN POLYGONS FOR JEFFERSON CANAL SPOIL PILE AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

27545-00(019)PR-BR023 12/20/2012

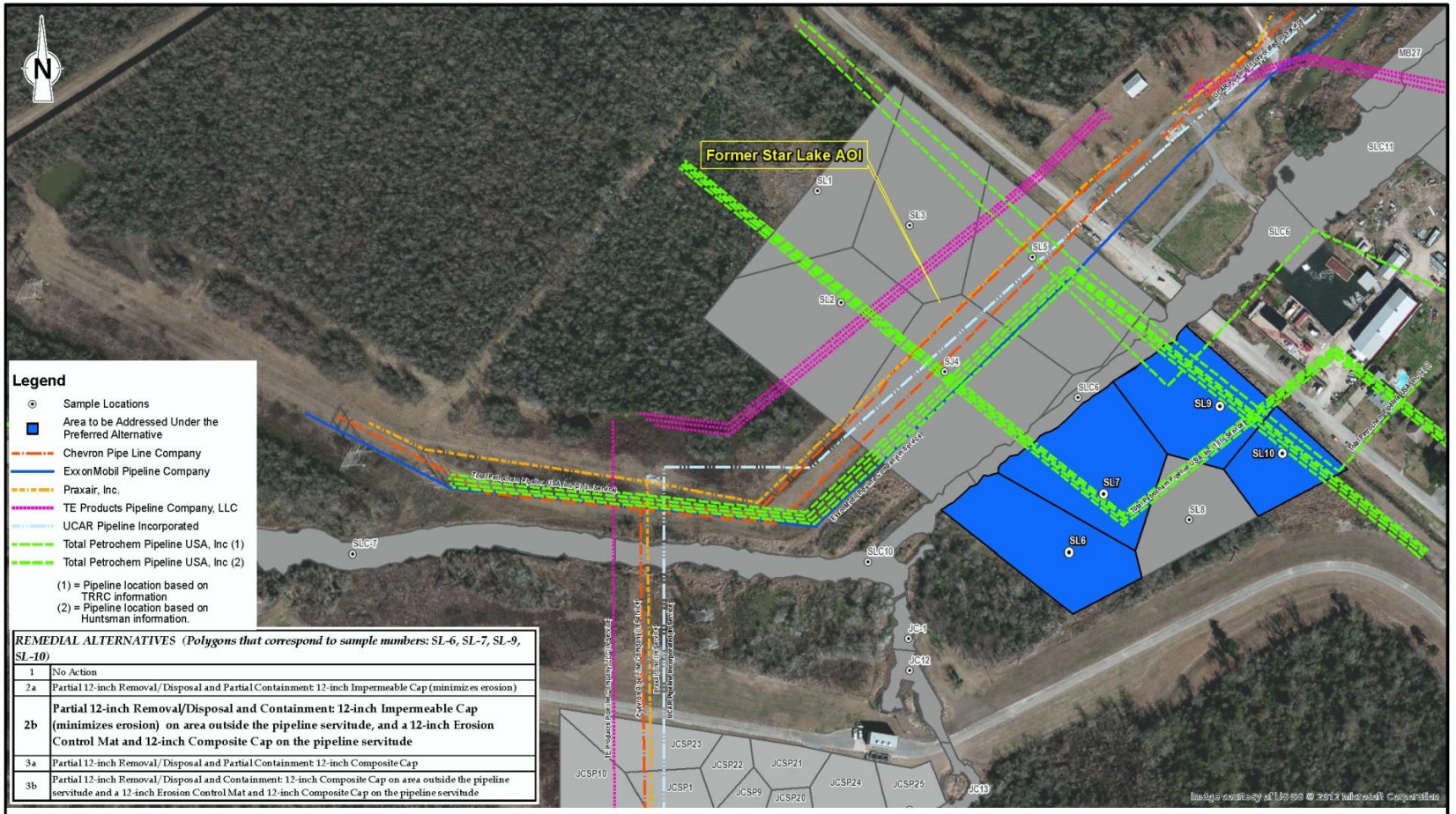


Figure 7
THIESSEN POLYGONS FOR FORMER STAR LAKE AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

27545-00(019)PR-BR024 12/20/2012

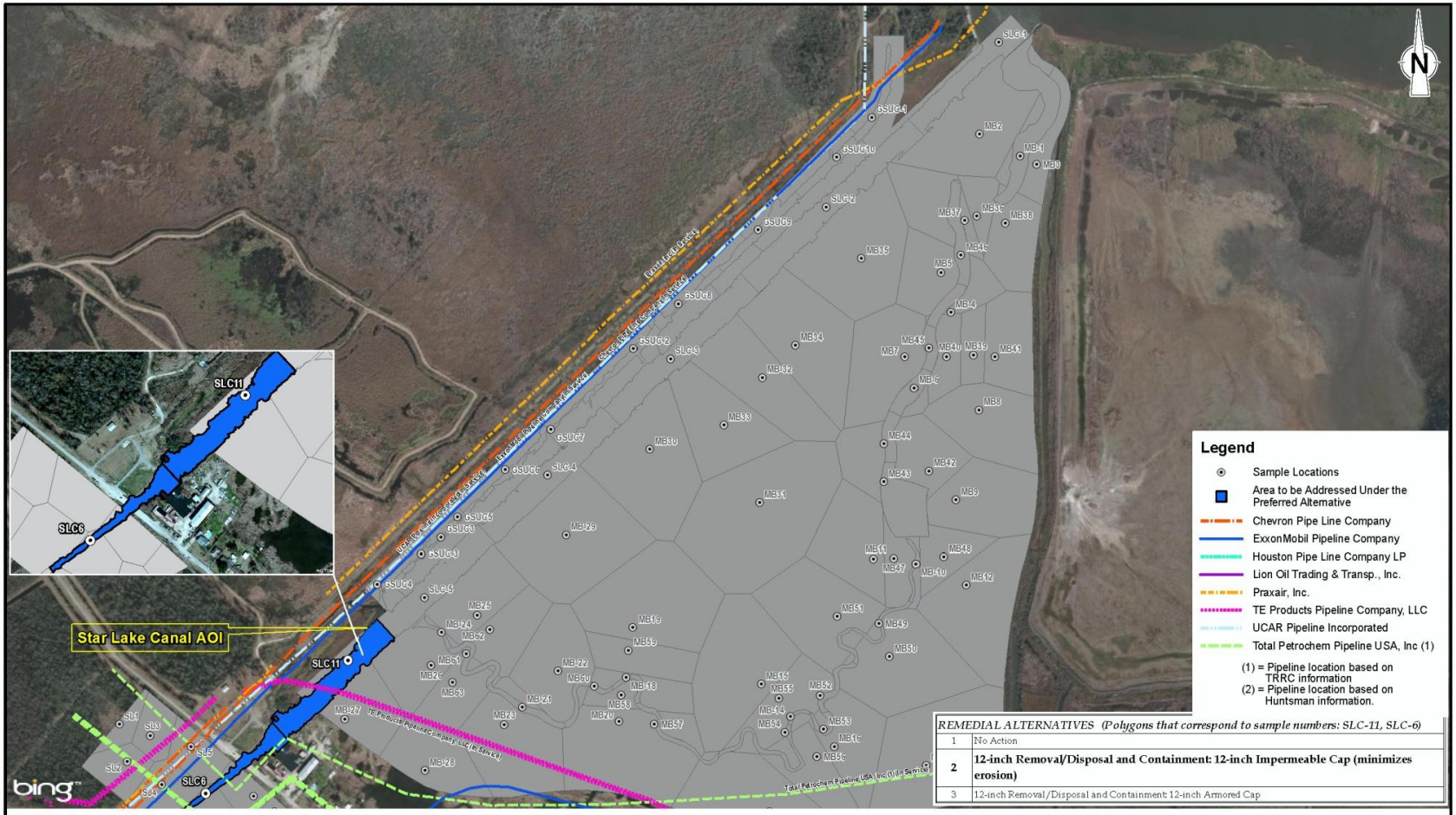
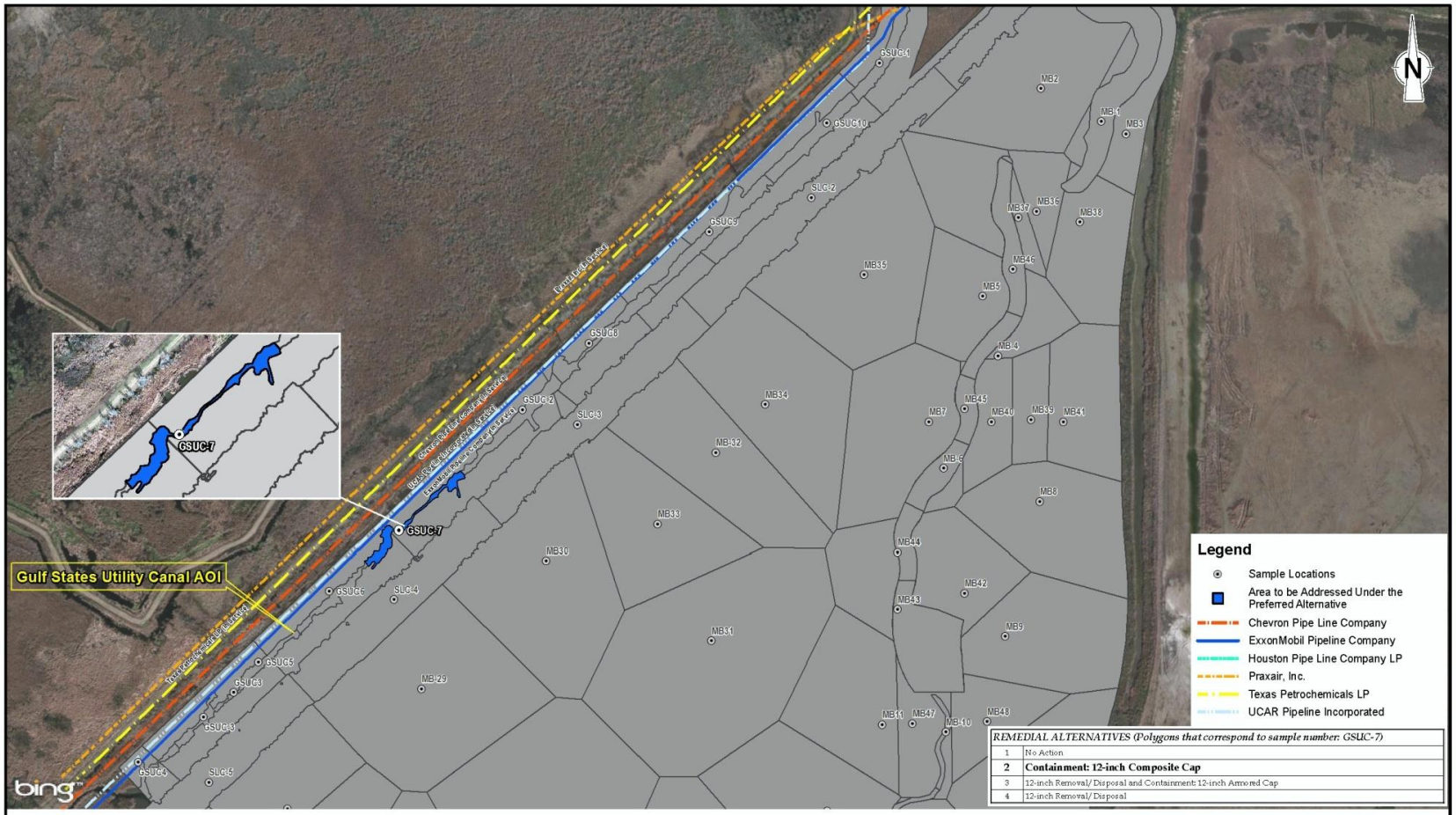


Figure 8
THIESSEN POLYGONS FOR STAR LAKE CANAL AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

27545-00(019)PR-BR025 12/20/2012



References:
2010 Aerial by Microsoft Corp and its data suppliers. Pipeline data obtained from the Texas Railroad Commission (TRRC) pipeline data set dated 2009, additional pipeline information provided by Huntsman, and site visit. Huntsman drawing no. F-Z-15-514 and F-Z-15-515.

Note:
Refer to Appendix B to view pipelines at or near every Area of Investigation (AOI).
Bold text indicates Preferred Remedial Alternative.

Figure 9
THIESSEN POLYGONS FOR GULF STATES UTILITY CANAL AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

27545-00(019)PR-BR026 12/20/2012

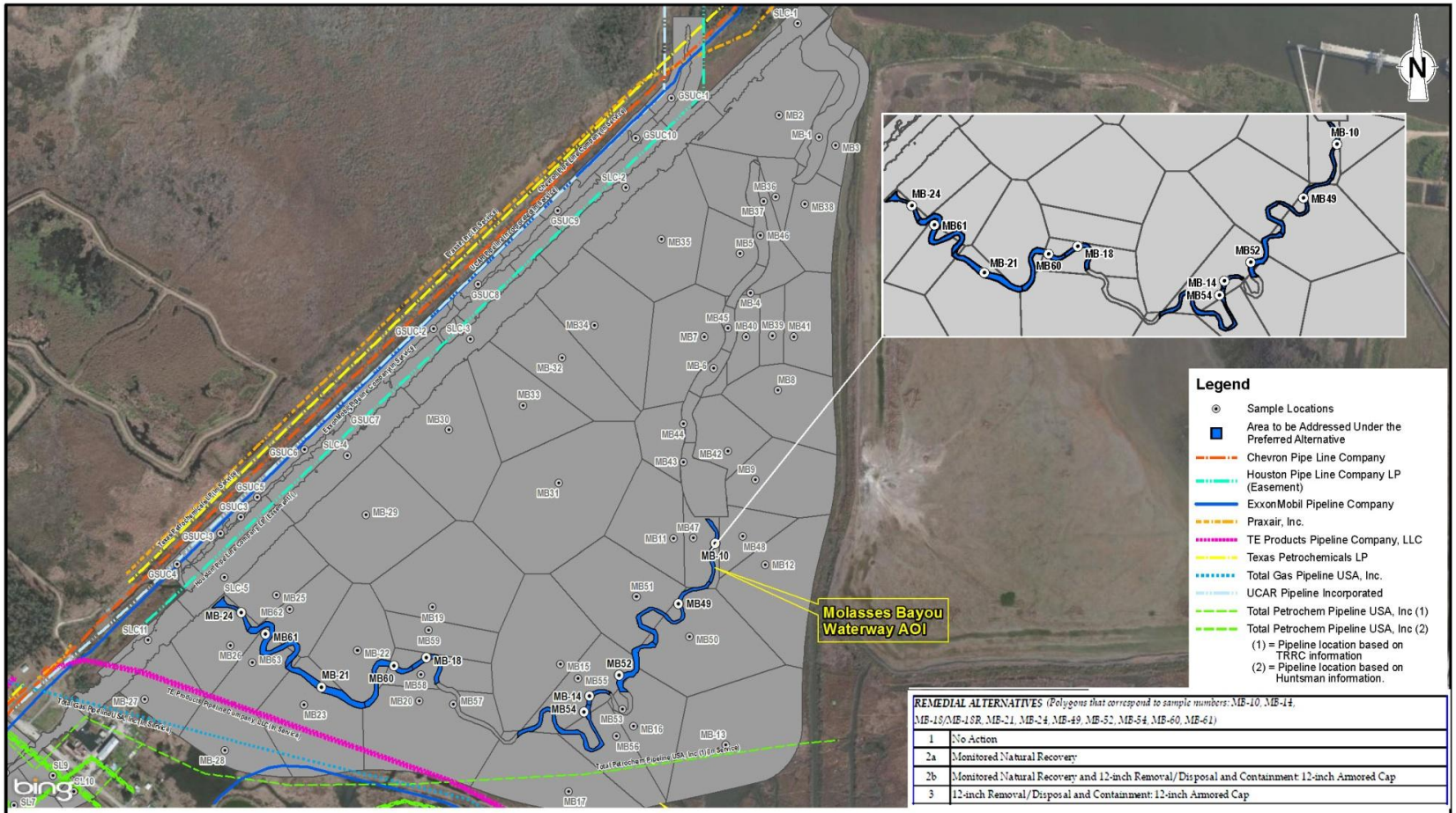
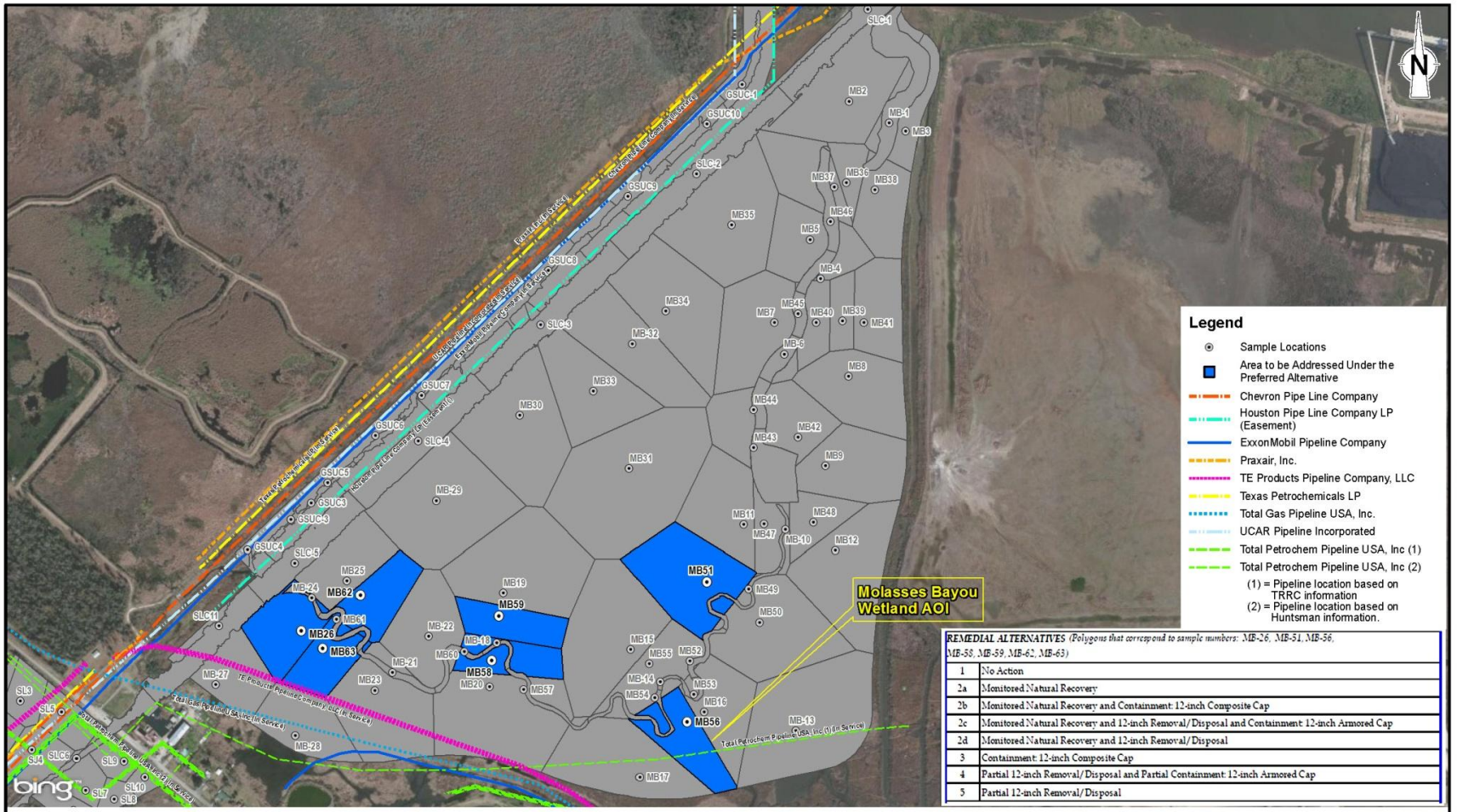


Figure 10
THIESSEN POLYGONS FOR MOLASSES BAYOU WATERWAY AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas



References:
2010 Aerial by Microsoft Corp and its data suppliers. Pipeline data obtained from the Texas Railroad Commission (TRRC) pipeline data set dated 2009, additional pipeline information provided by Huntsman, and site visit. Huntsman drawing no. F-Z-15-514 and F-Z-15-515.

Note:
Refer to Appendix B to view pipelines at or near every Area of Investigation (AOI).
Bold text indicates Preferred Remedial Alternative.

27545-00(019)PR-BR028 12/27/2012

Figure 11
THIESSEN POLYGONS FOR MOLASSES BAYOU WETLAND AOI
STAR LAKE CANAL SUPERFUND SITE, JEFFERSON COUNTY, TEXAS
Chevron Environmental Management Company, Houston, Texas

Table 1

Summary of Sediment Data

Constituent	Saltwater First Effect Level Sediment Benchmark (mg/kg)	Mean of Detected Values, Saltwater Sediment (mg/kg)	RME Saltwater Sediment (mg/kg) B	HQ Saltwater Sediment	Freshwater First Effect Level Sediment Benchmark (mg/kg)	Mean of Detected Values, Freshwater Sediment (mg/kg)	RME, Freshwater Sediment (mg/kg) B	HQ, RME, Freshwater Sediment
Antimony	-	2.868	3.016	**-**	2	-	5.08~/ 2.26*	**2.54**
Arsenic	8.2	7.867	8.037	**0.98**	**9.79**	12.62	16.7	**1.71**
Cadmium	1.2	0.741	0.459	**0.38**	**0.99**	0.598	**0.59**	**0.60**
Chromium	81	92.24	138.2	**1.71**	43.4	40.05	45.51	**1.05**
Chromium VI (Hexavalent)	-	11.23	7.043	**-**	-	-	9.0*	**-**
Copper	34	94.87	113	**3.32**	31.6	196.2	357.4	11.31
Lead	46.7	108.8	140.4	**3.01**	35.8	45.4	57.14	**1.60**
Mercury	**0.15**	**0.36**	0.477	**3.18**	**0.18**	0.0839	0.117	**0.65**
Selenium	-	**6.39**	11.5	**-**	-	-	7.22~/ 2.67*	**-**
Silver	1	1.332	**0.91**	**0.91**	1	1.747	2.089	**2.09**
Vanadium	-	59.94	63.08	**-**	-	58.38	71.91	**-**
Zinc	150	125.7	140.8	**0.94**	121	166.6	238.8	**1.97**
Aroclor-1016	-	-	1.0~	**-**	0.007	-	2.5~	357.14
Aroclor-1221	-	-	1.0~/ 0.00982*	**-**	-	-	3.9~	**-**
Aroclor-1232	-	-	1.0~	**-**	-	-	2.5~	**-**
Aroclor-1242	-	0.784	0.747	**-**	-	0.378	0.369	**-**
Aroclor-1248	-	0.296	0.114	**-**	**0.03**	4.719	2.764	92.13
Aroclor-1254	-	0.362	0.288	**-**	**0.06**	**0.79**	0.821	13.68
Aroclor-1260	-	**0.11**	0.0963	**-**	0.005	0.148	0.115	23.00
4,4'-DDE	-	0.0273	0.0125	**-**	-	-	0.47*	**-**
4,4'-DDT	-	0.012	0.016	**-**	-	-	0.069~	**-**
Dieldrin	0.000715	0.0138	**0.02**	27.97	0.0019	0.118	0.105	55.26
Endosulfan II	-	-	1.8~	**-**	-	-	0.069~	**-**
Endosulfan sulfate	-	0.00435	0.00202	**-**	-	-	0.069~	**-**
Pentachlorophenol	-	**0.81**	0.598	**-**	0.504	**23.76**	21.3	**42.26**
2-Methylnaphthalene	**0.07**	3.032	4.782	**68.31**	-	0.3	0.757	**-**
Acenaphthene	0.016	2.988	4.775	**298.44**	0.0067	4.503	**11.81**	**1762.69**
Acenaphthylene	0.044	**3.04**	4.542	**103.23**	0.0059	7.012	**17.98**	**3047.46**
Anthracene	0.0853	2.057	3.463	**40.60**	0.0572	4.671	**26.98**	**471.68**
Benzo(a)anthracene	0.261	1.122	1.613	**6.18**	0.108	2.551	**4.92**	**45.56**
Benzo(a)pyrene	**0.43**	**0.95**	**1.43**	**3.33**	**0.15**	1.831	3.268	**21.79**
Benzo(b)fluoranthene	-	0.773	1.039	**-**	-	1.001	2.342	**-**
Benzo(e)pyrene	-	**0.73**	2.498	**-**	-	1.383	4.3	**-**
Benzo(g,h,i)perylene	-	0.329	0.341	**-**	-	0.349	0.818	**-**
Benzo(k)fluoranthene	-	0.457	0.508	**-**	-	1.135	1.471	**-**
Chrysene	0.384	1.199	1.849	**4.82**	0.166	2.539	4.915	**29.61**
Dibenz(a,h)anthracene	0.0634	0.124	0.167	**2.63**	0.033	0.164	0.224	**6.79**
Fluoranthene	0.6	2.172	4.693	**7.82**	0.423	4.812	**9.18**	**21.70**
Fluorene	0.019	2.583	4.138	**217.79**	0.0774	0.741	0.869	**11.23**
Indeno(1,2,3-cd)pyrene	-	0.296	0.333	**-**	-	0.319	**0.76**	**-**
Naphthalene	**0.16**	3.709	5.121	**32.01**	0.176	0.215	0.456	**2.59**
Perylene	-	0.169	0.328	**-**	0.204	0.347	0.917	**4.50**
Phenanthrene	**0.24**	6.1	**10.98**	**45.75**	-	**15.64**	**52.43**	**-**
Pyrene	0.665	4	6.574	**9.89**	0.195	10.3	**28.36**	**145.44**
Total PAH	4.022	**43.41**	**89.45**	**22.24**	**1.61**	17.8	**67.75**	**42.08**
Carbon disulfide	-	0.0115	0.0163	**-**	0.12	0.0109	0.0128	0.11
Ethylbenzene	0.65	0.238	0.0808	0.12	2.86	0.156	0.177	0.06

Notes:
The RME (reasonable maximum exposure) is the 95% UCL unless specified as * or ~
For hazard ratio calculations, measured methyl mercury concentrations were converted from nanograms per gram (ng/g) to milligrams per kilogram (mg/kg).
*RME is representative of the maximum detected concentration.
~The RME is representative of the maximum sample quantitation limit (SQL) . In cases when the maximum SQL is higher than the maximum detected value, the maximum SQL was compared to the appropriate
benchmark as a conservative determination of the Hazard Ratio.

LIST OF ACRONYMS

AOC	Administrative Order on Consent
AOI	Area of Investigation
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
BERA	Baseline Ecological Risk Assessment
CEMC	Chevron Environmental Management Company
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of the Federal Register
COC	Contaminant of concern
COPEC	Contaminant of potential ecological concern
DDD	Dichloro-diphenyl-dichlolorethane
DD #7	Jefferson County Drainage District Number 7
EPA	U.S. Environmental Protection Agency
ERM-Q	Effect Range Medium Quotient
ESI	Expanded Site Investigation
FS	Feasibility Study
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
mg/kg	Milligrams per kilogram
MNR	Monitored natural recovery
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCL	Protective Concentration Level
PEL-Q	Probable Effect Level Quotient
PNPP	Port Neches Performance Products (Huntsman facility)
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RBL	Risk-Based Exposure Limit
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SLERA	Screening level ecological risk assessment
SSI	Screening Site Inspection
SVOC	Semi-volatile organic chemical
TCEQ	Texas Commission on Environmental Quality
TBC	To-be-considered
TDH	Texas Department of Health
TDSHS	Texas Department of State Health Services
TDWR	Texas Department of Water Resources
TNRCC	Texas Natural Resource Conservation Commission

TRRP	Texas Risk Reduction Program
TSCA	Toxic Substances Control Act
UTL	Upper trophic level
VOC	Volatile organic chemical